Windows 98 - Avoiding The Install Traps

SILICON CHIP

NOVEMBER 1998
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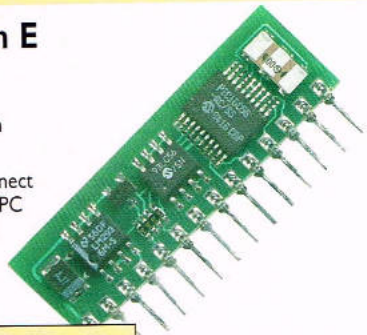

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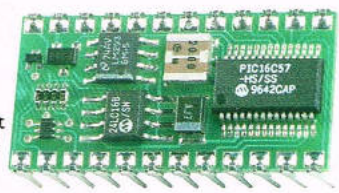

- Features 16 I/O lines
- 2048 bytes EEPROM (program and data)
- 500 instructions maximum program length
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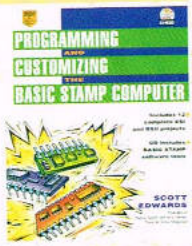

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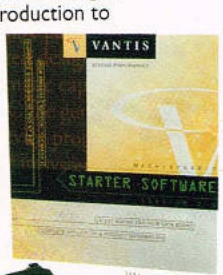

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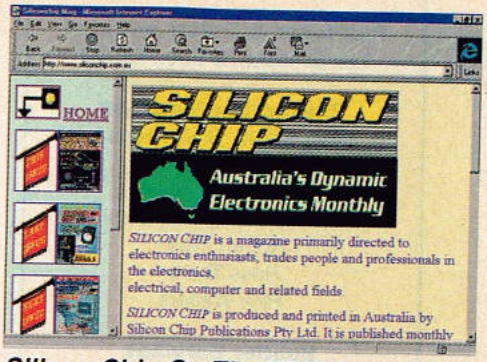
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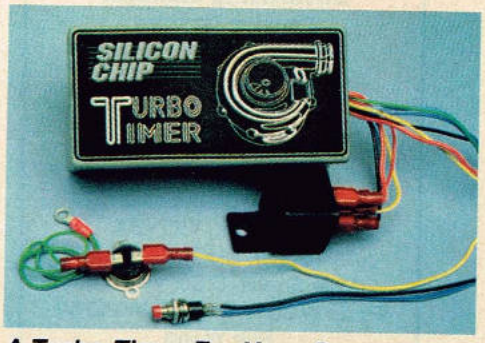

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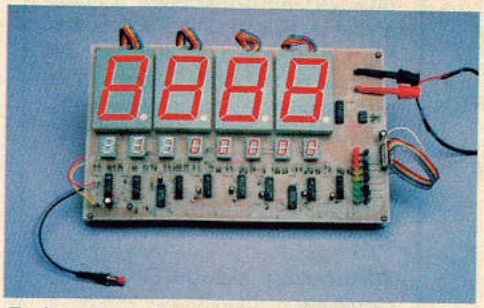

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PUBLISHER'S LETTER

It is time to start employing more people

Now that the Federal election is out of the way, maybe the Government can start seriously addressing Australia's major problem: unemployment. We have gone too far down the road to "lean and mean" corporations, both government and private. It is time to reassess what all the huge job losses over the last ten years or so have meant for Australians. For those who have lost their jobs it has generally meant a fringe existence, wondering if they will ever have a proper job again and a great loss of self-confidence. For the wider community, it has meant rising crime, drug abuse and suicides. And it has also led to a general lowering of service standards right across government and private enterprise.

This has been typified by the recent debacles of Sydney's water parasite infestation, Victoria's loss of gas supplies and Brisbane's electricity blackouts. The fact is that in most government utilities and in many of the larger companies, there are just not enough people, particularly qualified people, to do the job. Maintenance is not being done and overall safety levels are dropping. Companies and government organisations simply cannot provide the service levels that used to be delivered.

If you need convincing, just try phoning any large or medium sized company or government body. You will no doubt need to phone a 131 number and then you will be placed in an interminable queue. "Your call is important to us, please hold and etc, etc", is the drivel you have to put up with in between listening to some irritating music-on-hold. And then when you do finally get to talk to a human, you will often find that he/she hasn't a clue what you're talking about and there is no guarantee that your request/report or whatever will be acted upon.

These companies and organisations are clearly not attempting to provide proper levels of service and ultimately, they will suffer in the long term. So will their customers.

The situation is now so bad that it is a real pleasure to phone a company or organisation and find that not only do they answer the phone quickly but a real person answers. If they are able to quickly help, then so much the better. Thankfully, in the electronics business, most companies still have real people answering the phones and some provide very good levels of service. You can only do that if you have adequate numbers of people who are trained to do their jobs.

For the future, the Government must actively start encouraging companies to employ more people. The Government likes to talk about how many jobs it has created over a period. That is nonsense; governments don't create jobs, they destroy them.

For their part, companies need to review their long-term strategy (if they have one). They need to realise once more that the only way to grow and make more profits is to invest heavily in their people and ultimately, to employ more people.

And many Australians need to realise that profit is not a dirty word. If companies don't make profits, they can't afford to employ people.

Leo Simpson

MicroGram Computers

Internal UPS & Power Supply

It's not just a UPS but also a 300W power supply. The UPS is actually built into a standard size power supply and the batteries and front panel occupy a 5.25in drive bay. The UPS is rated at 500VA. Apart from power failure, the UPS also protects against over voltage, under voltage, overload & DC short circuit. The unit is available in two sizes - PS/2 or ATX. Optional software provides for automatic shutdown.

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When desk space is at a premium an 80 key keyboard with full 101 key functionality will come in handy. It has dimensions of only 297(W) x 152(L) x 30(D) mm.

Cat. No. 8238 **Compact 81 Key** $69

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This infra red compact keyboard features 86 keys with Win 95 104 key functionality. It features membrane keyswitch with tactile feedback, an effective operating angle of 360 degrees over a distance of 7 metres and low power consumption with high efficiency power management for long life operation. Two buttons at the upper left serve as clicking devices. The infra red receiver has a 6-pin PS/2 mouse connector and standard 5-pin keyboard connector.

Cat. 8655 **Keyboard IR Cordless** $149

PCMCIA Bar Code Wand

The Bar Code Wand lets you use your handheld PC to collect bar code data directly into any Windows CE application. When you move the wand across a bar code, Windows CE programs behave as though you typed the data in, eliminating the need for special programming. You can replace expensive, dedicated data collection terminals with your H/PC and perform an unlimited variety of computational tasks right at the point of data capture.

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Year 2000 BIOS Card

Even Pentium motherboards are not immune to the Year 2000 bug! - so don't leave it 'till it's too late. The Year 2000 BIOS Card solves the problem of progression from 1999 to 2000 as well as 21st century leap years. It is an 8-bit card which provides year 2000 support for motherboards with a BIOS which only stores the year with two digits. i.e. 97 instead of 1997.

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Whether you require a line interactive or true on-line UPS, we have the right one for you. From entry level UPS's for stand alone PC's to intelligent microprocessor controlled UPS's for professional high performance file server applications.

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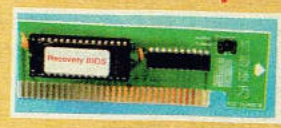
Mouse Tablet

The Mouse Tablet 604 is an extraordinary input device that allows you to choose between an easy-to-use, high resolution, trackball-free mouse or an absolutely precise stylus pen. Both pointing devices are implemented with cutting-edge electromagnetic technology, and have a resolution up to 4064 LPI. The three-button stylus pen provides pinpoint accuracy and writing, drawing & painting abilities. Bundled software includes NetProbe (a built-in Internet direct access utility), PenSurfer and PenGuard.

Cat. 8676 **Mouse Tablet** $159

Hard Drive Recovery Card



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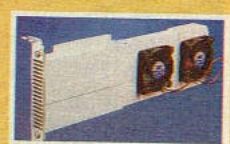

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Noticed any extra wording on the cover of SILICON CHIP lately? Go on, have a look – we'll wait for a few seconds . . .

Good: you're back. Did you notice it? That blue writing right underneath the barcode, high up on the right hand side.

"www.siliconchip.com.au"

Ah, that wording! But what does it mean? And what does it mean to you, the SILICON CHIP reader?

The World Wide Web

The last figures we saw suggested that about 30% of Australian households now had access to the Internet, or more specifically the World Wide Web (WWW). While that's a pretty impressive statistic (we don't believe it, by the way!), it's sobering to look at it from the other direction – about 70 percent of households DON'T have access.

And while SILICON CHIP readers are pretty switched on, we thought a bit of explanation would be in order before we go on to describe what you will find on our web pages.

Most people believe that the Internet is a very recent phenomenon. The truth is that the Internet has been around for at least three decades.

Depending on which source you read and believe, the Internet was set up either by a group of academics to transfer information between universities or by the US military as a form of "bullet proof" (or more likely atom bomb proof) means of transferring data.

One of the beauties of the Internet is that no-one actually owns it. The computers which form the various gateways to the Internet are of course owned – but take out one of those computers and there will always be another, somewhere else in the network, to take its place.

Therefore controlling access to the Internet is somewhat difficult, if not impossible, to achieve. This tends to explain why you can find all sorts of things on the Internet which governments and other bodies around the world would rather not be there.

You will note that so far we have talked about the "Internet" and not the World Wide Web. The reason for this is that the WWW is just a part (albeit a significant part) of the Internet. It is, if you like, the "window" (yes, the pun was intended) for the average person to look into the Internet and, more importantly, understand what is there.

Without the WWW the Internet would be a mass of meaningless data to most people. The WWW puts a "graphical" face on the Internet, allowing anyone to use it without having to know the language or protocols involved.

Speaking of language, we now start getting into some of those acronyms so loved by computer people.

Information on the WWW is programmed in a language called HyperText Mark-Up Language, or HTML. The WWW transfers this information in a protocol, or standard, called HyperText Transfer Protocol - you guessed it, HTTP.

When computer files are to be transferred between web sites, the standard most often used is File Transfer Protocol, or FTP.

Now you know all that, let's look at the SILICON CHIP website name and see what makes it up. "www.siliconchip.com.au" is called the Universal Resource Locator, or URL, for the SILICON CHIP web site. Actually that in itself is a bit of an abbreviation: the full URL would be http://www.siliconchip.com.au.

As we said before, "http" identifies the format of the protocol used. The "www.siliconchip.com.au" part is called the domain, made up as follows: "www" is, of course, the world wide web and "siliconchip" is the name registered to identify SILICON CHIP 's particular web site. The "com' part refers to the type of organisation owning the web site – in this case a commercial organisation. You may also see identifiers such as

"edu" for educational institutions, "gov" for governments or government departments, "net" for internet service providers, "org" for non-commercial organisations such as charities, groups, etc (although many use "com"), and so on.

Finally, the "au" identifies the web site as originating in Australia. A New Zealand website would be followed by "NZ", Japanese "JA" and so on. If there is no country identifier, it usually means that the website has been registered in the USA.

How do you access www.siliconchip.com.au?

There are four things you're going to need. First and most important is a computer. Somewhat surprising to many people is that the computer doesn't have to be the latest and greatest. If you've upgraded your computers at work and have a 486 sitting there gathering dust, you could press it into service.

The second thing you're going to need is a modem. That's another acronym, standing for MODulator/DEModulator: its job is to convert the digital signals from your computer into analog signals which can be sent down a phone line.

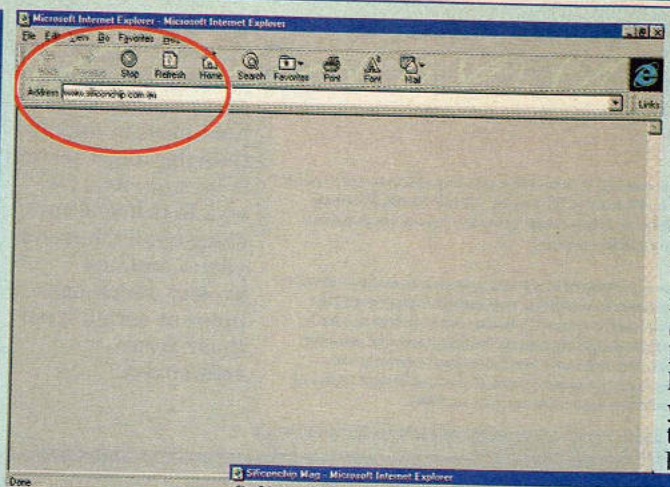
Phone line? Yes, your ordinary line is fine - just bung in a telephone line double adaptor into the wall socket and your modem and phone can operate on the one line.

As far as the modem itself is concerned, here it is important to have the latest model possible, because for modems, older equals slower. When you use the Web, you'll understand why it has been disparagingly referred to as the World Wide Wait. As a minimum, your modem should be rated at 33.6K; 56K is better (and currently the fastest standard phone line modem available).

The third thing you're going to need is an ISP account (that stands for Internet Service Provider). This is the company whose job it is to connect you to the internet and there are many such companies. There are the big boys such as Telstra Big Pond and Ozemail, and there are hundreds upon hundreds of very small ISPs, most of whom you have probably never heard.

Which ISP do you go for? We hoped you wouldn't ask that! There are so many variables here, not the least of which is cost.

With some ISPs you pay a flat rate each month for unlimited access – very



"Logging On" to SILICON CHIP's website is easy: type the URL (universal resource locator) *www.siliconchip.com.au* in the "address" box in your web browser. (There may be some default site already listed). Hit the enter key and next thing you see should be the web page below!

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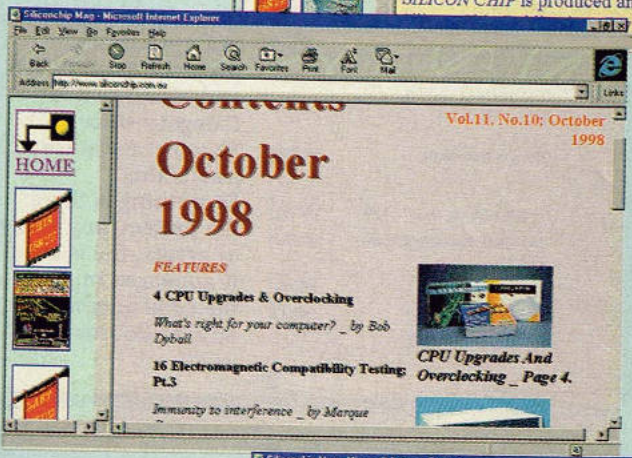
The home page has two parts: the table of contents panel at left, and the user-selectable panel at right. Clicking on any of the items in the left panel will change the contents of the right panel. You can also click on many of the right panel objects to go deeper into the website.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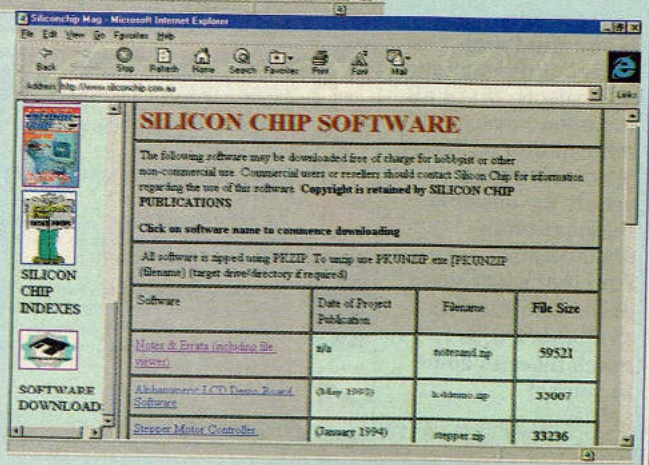
Immunity to interference _ by Marque
CPU Upgrades And Overclocking _ Page 4.

For example, clicking on any of the displayed magazine covers will open up the contents page of that issue, complete with pictures. You can even click on the cover pic to see it in larger format!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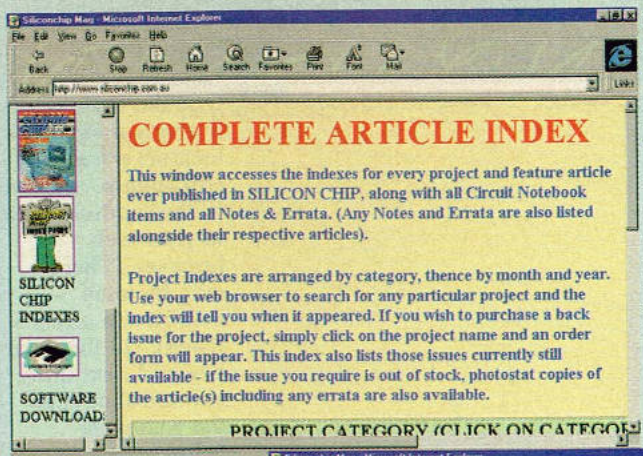
COMPLETE ARTICLE INDEX
This window accesses the indexes for every project and feature article ever published in SILICON CHIP, along with all Circuit Notebook items and all Notes & Errata. (Any Notes and Errata are also listed alongside their respective articles).
Project Indexes are arranged by category, thence by month and year. Use your web browser to search for any particular project and the index will tell you when it appeared. If you wish to purchase a back issue for the project, simply click on the project name and an order form will appear. This index also lists those issues currently still available - if the issue you require is out of stock, photostat copies of the article(s) including any errata are also available.
SILICON CHIP INDEXES
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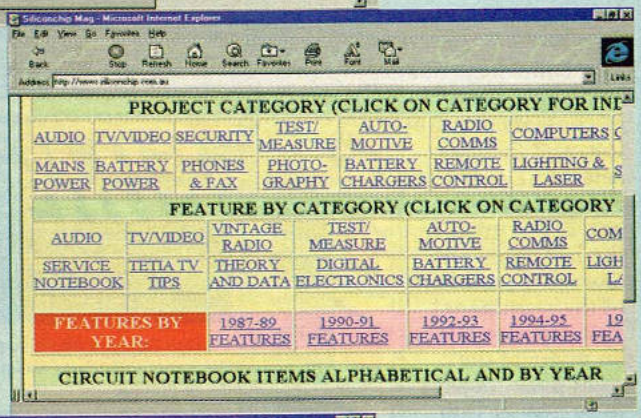
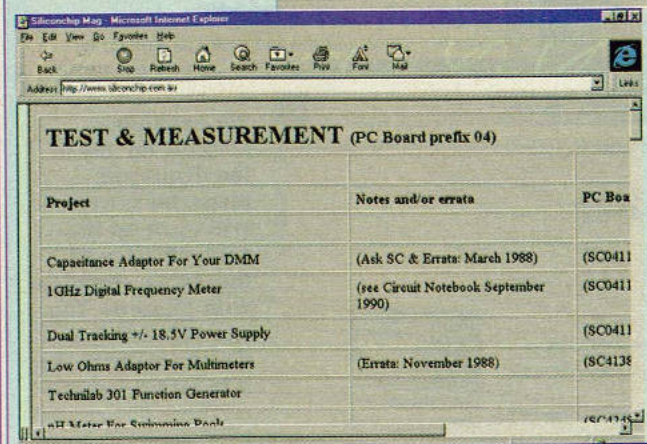
If you need to find out when a particular project, feature or other article was published in SILICON CHIP the index section is for you. Every article is listed by category, by date, by year – and any project which has notes or errata have those cross-referenced.

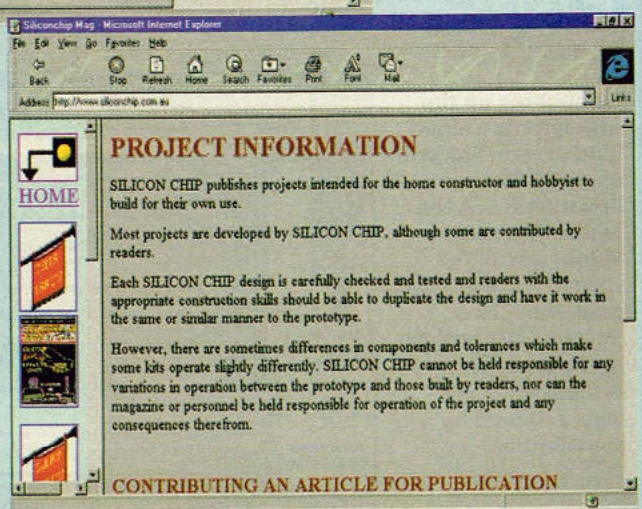
You can open a certain category and then use your browser's "search" function to find any word - or you can even download a complete SILICON CHIP index complete with its own search engine!





Here's a typical example: every project from the "Test and Measurement" Category since SILICON CHIP started publishing. Everything is there: the project, any notes or errata, the issue(s) it appeared in, even the code number of any PC Boards it used!

If you need any general information on projects, that's all there too - even information on how to contribute an article for possible publication in SILICON CHIP. And that's just some of the information available - with much more to come in future!


PROJECT INFORMATION
HOME
SILICON CHIP publishes projects intended for the home constructor and hobbyist to build for their own use.
Most projects are developed by SILICON CHIP, although some are contributed by readers.
Each SILICON CHIP design is carefully checked and tested and readers with the appropriate construction skills should be able to duplicate the design and have it work in the same or similar manner to the prototype.
However, there are sometimes differences in components and tolerances which make some kits operate slightly differently. SILICON CHIP cannot be held responsible for any variations in operation between the prototype and those built by readers, nor can the magazine or personnel be held responsible for operation of the project and any consequences therefrom.
CONTRIBUTING AN ARTICLE FOR PUBLICATION

good if you use the 'net a lot. With others, you pay a flat rate for a certain number of hours each month. They're usually a bit cheaper but if you exceed the number of hours of your contract you can pay a lot of money. Finally, there are ISPs who charge you by the hour for what ever time you are on.

Beware, though, some of the latter charge you in "blocks" of time, so even if you're only on the net for a few minutes, you might be charged for a lot longer. (By the way, be very wary of so-called "free" web sites which ask for credit card numbers as "proof of age". You know which sites we mean...)

The next question you need to ask is how much is it going to cost me to call the ISP. Is it a standard local call, a timed local call (betcha thought we didn't have such things!), a community call or an STD call?

For readers in the major cities, there are usually plenty of ISPs to choose from. Outside the major cities, it's quite often a better deal to sign up with a local ISP who charges a bit more but you get the benefit of local calls.

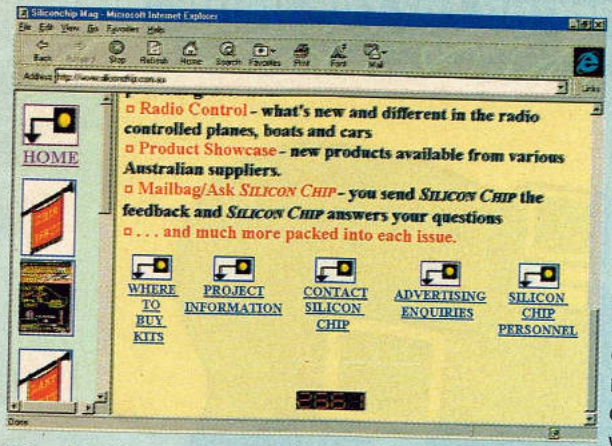
You also need to look at the costs of help. Especially in the setup period you may need help – and it may cost you. Some ISPs have free 24-hour-a-day help, others have limited free help, others charge for help at any time.

One of the best ways to seek out an ISP is to ask friends who access the Internet. How much does it cost them? Are they happy?

We did this once and the friend (who was signed up with one of the major ISPs) still hasn't stopped moaning about how big his bills are!

The fourth thing you're going to need you probably already have (how's that for double Dutch?) It's a web browser program and if you've installed Windows 95 or Windows 98 on your computer, you should see a map of the world on your desktop with the words "Internet Explorer" underneath it.

That is Microsoft's Internet Explorer, version 3 or 4. Either works fine, as does the opposition product, Netscape's Navigator. It's a matter of preference which browser you use – both work in similar ways but some are more suited to some web sites than others. The SILICON CHIP web site is happy with either. They're not the only browsers; there are dozens and dozens of others out there, some of which


Radio Control - what's new and different in the radio controlled planes, boats and cars
Product Showcase - new products available from various Australian suppliers.
Mailbag/Ask SILICON CHIP - you send SILICON CHIP the feedback and SILICON CHIP answers your questions
. . . and much more packed into each issue.
HOME
WHERE TO BUY KITS
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ADVERTISING ENQUIRIES
SILICON CHIP PERSONNEL

There's plenty more in store so keep logging on! Want something added? Ask us and we'll see what we can do. . .

have built up a real following. Many are available as downloads from other web sites.

Logging On

Once you have your computer and modem set up and have signed up with an ISP you are ready to access the web. Before you do, though, unplug any other phone connected to the same line as your modem (just in case someone picks it up and starts dialling) and disable call waiting (see your telephone book).

We'll assume you have tested your modem and software. We'll also assume you're using Internet Explorer.

You can dial your service provider first then start your web browser, or you can start your web browser first.

Just down from the top of the screen is a line beginning with "address" and a field that is either blank, or has something like C:\windows\system\blank.htm

This is where you enter the URL of the website you're connecting to. In this case, you enter www.siliconchip.com.au

Note that there are no spaces – periods (full stops) separate the components of the URL. Also, the "http://" at the start can be left off with most web browsers because that is their default. (Some browsers don't even need the "www." for the same reason but it's a good idea to include it).

If you are already logged on to your ISP provider, a line at the bottom of the screen will change to "searching for site www.siliconchip.com.au", followed by a message "website found - awaiting reply". Before too long the SILICON CHIP web site "home page" appears and you're ready to rock'n'roll!

What's on www.siliconchip. com.au?

The home page is divided into two panels. On the left is a table of contents panel which doesn't change; on the right is a much larger panel which changes according to what you select.

As you move your cursor over the left panel, from time to time it will change to a hand.

When this happens, the cursor has found a "hot spot" with a link to another page or section. Clicking once on a hot spot makes the link. At the moment, the table of contents has the following hot spots:

THIS ISSUE – clicking once on either the flag or cover picture will load the contents page for the current issue, that is the one on sale now or, depending on the date, the one just past.

PREVIOUS ISSUE – links to the contents page of the issue which has just come off sale

NEXT ISSUE – After about the 15th of the month, links to the contents page of the issue due on sale next month. This page is updated only after the next issue is finalised – until then it could be the issue currently on sale.

SILICON CHIP INDEXES – Links to the master index page which then links to a large range of index pages.

There are indexes for major articles in all issues, projects (arranged by type and then by date of publication), features (same arrangements), circuit notebook articles, notes and erratas – in fact, what ever way you wish to search we think we have it covered.

You can use your web browser's "find" function to search for any particular project or article in which you are interested.

For example, log on to the "Service Notebook" pages and you can search for a particular brand TV set that's giving you trouble. Your problem might have already been solved!

And if that's not enough, there is also a master index, complete with its own inbuilt browsing function, which you can download.

SOFTWARE DOWNLOADS – Speaking of downloads, this area contains the SILICON CHIP software which you used to have to pay for – all free to download! Note that while it is free, Silicon Chip Publications retains the copyright.

Naturally, software is not available from contributed articles where the author has retained copyright.

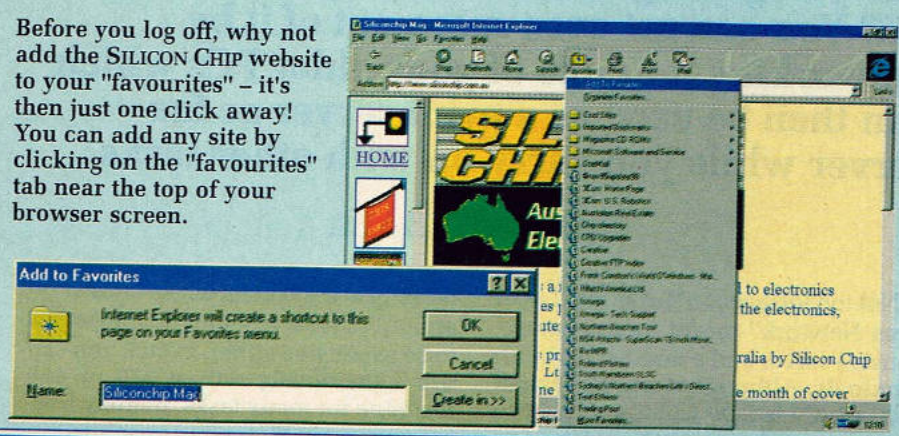
Near the bottom of the home page, there are several buttons which are also hot spots. Click on these and you will find information on how to contact SILICON CHIP, the people who bring you the magazine each month, advertising details including material specifications, information on projects, kits and where to obtain them, and much more.

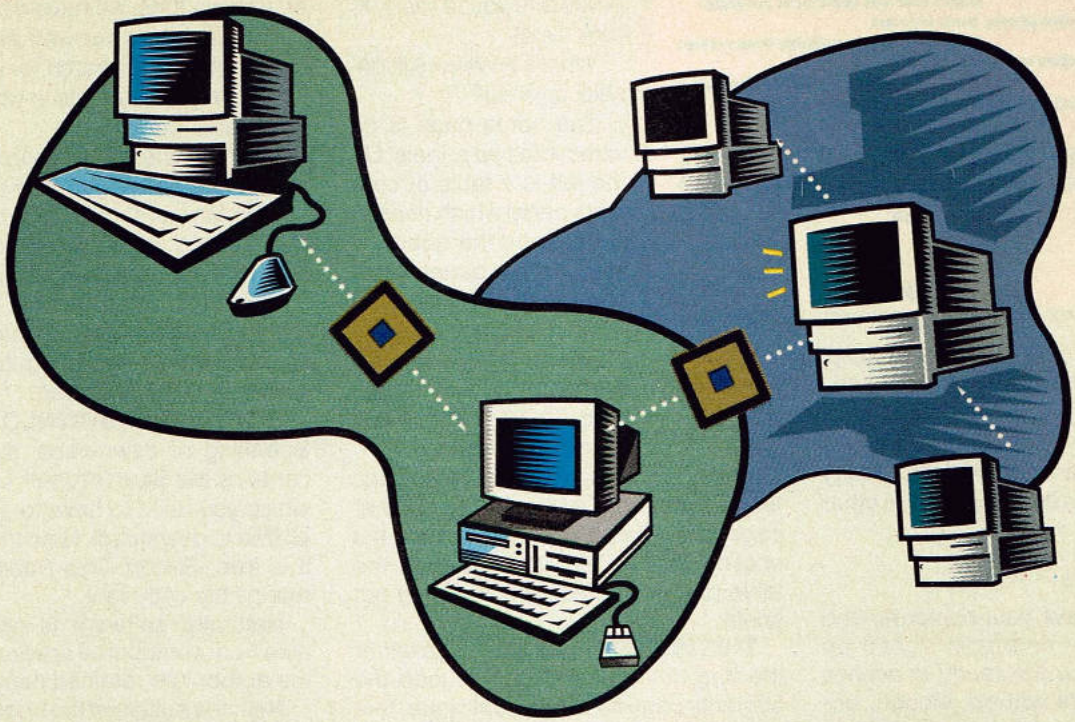
And that's just the start.

The SILICON CHIP web site will constantly be evolving. Shortly we plan to increase the size and function of our web page significantly.

In the meantime, log on to www.siliconchip.com.au – we hope you like what you find! **SC**

Before you log off, why not add the SILICON CHIP website to your "favourites" – it's then just one click away! You can add any site by clicking on the "favourites" tab near the top of your browser screen.





Beyond The Basic Network

Setting up a LAN using TCP/IP

Are you getting the best out of your current PC? You can get even more out of it by networking it to one of your older PCs which can then be used as a print server or fax server while you carry on with other tasks.

By BOB DYBALL

Not too long ago, a "LAN" or "Local Area Network" meant having an expensive server and a number of dumb terminals. Although it can still mean this, a LAN is now usually a "peer to peer" network, consisting of two or more PCs which can act as both servers and clients. A server no longer has to be expensive either. In fact, you can use a previously retired 386 or 486 machine for many tasks, thereby freeing your main PC for more useful jobs.

Whether you are in a small office or just at home, take a look at what networking can do for you. For example, a LAN will allow you to:

- share a printer;
- share files or programs;
- share a modem for fax or Internet access;
- set up a small web server and Intranet;
- study networking to further your education; and
- play games against other family members and friends.

Obviously there are many different things that you can do but where should you start?

The first thing to do is take a look at your needs and the resources you have available. For example, let's say that you have a small office with three or four people and you've recently upgraded your last remaining 486 PC to a Pentium machine. Before tossing the old 486 onto the scrapheap, consider putting it to use as say a fax server and printer server. That way, everyone in the office can easily print to the same printer and have access to a modem, provided that they're part of the network.

On the home front, you may have a laptop that's used for work plus a fairly new PC that's used by the kids. In addition, you may also have an old 386 machine that's been retired, or you know where to acquire one quite cheaply.

Now here's the problem: both you and the children need to get onto the net but you'd like to avoid having extra phone lines (and modems). You are also concerned about what they might see on the net. A LAN can help here and, with the right software, provide a "gateway" to the net that is safe and convenient. And you will only need one modem for everyone.

Setting up a LAN involves installing a network card in each PC involved. For a laptop, the network card might be a plug-in PCMCIA or PC card device, while for older PCs it will be a 16-bit ISA network card. Pentium or later machines can be fitted with either ISA or PCI network cards.

Networking options

Two main types of LANs are commonly used in small "peer to peer" systems. The cheapest to set up is known as 10Base2. It uses RG-58 coaxial cable and network cards that have BNC connectors fitted. The PCs are simply connected together in daisy-chain fashion (see Fig.1), with the cable run via T-connectors on each PC. The two ends of the chain are fitted with 50-ohm terminators.

The other common system is known as 10BaseT. This type of system requires a "hub", which provides a central connection point for the network – see Fig.2. It uses flat twisted-pair cable fitted at either end with RJ-45 connectors (similar to telephone connectors).

A hub costs $50 or more for a small 5-port model but you can also buy 8-port and 16-port hubs if required. Because a hub is not needed for 10Base2, many home users opt for this type of network. It's cheaper but a break anywhere in the cable usually means that the whole network stops working.

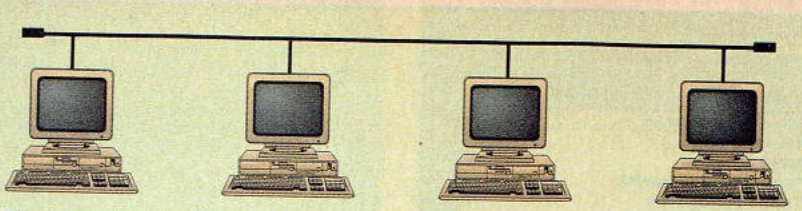


Fig.1: a 10Base2 (thin Ethernet) network uses coaxial cable and network cards that have BNC connectors fitted. The PCs are connected together in daisy-chain fashion, with the cable run via T-connectors on each PC. The two ends of the chain are fitted with 50-ohm terminators.

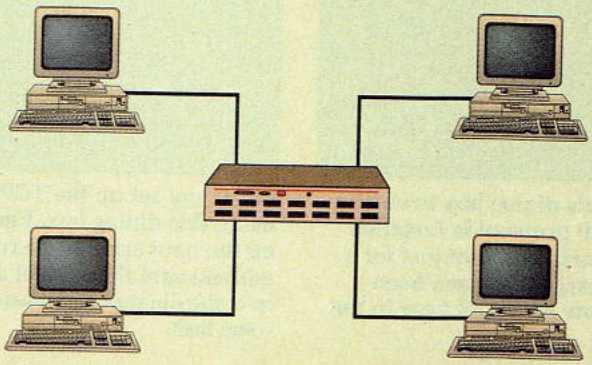


Fig.2 the 10BaseT system requires a "hub", which provides a central connection point for the network. It uses flat twisted-pair cable fitted at either end with RJ-45 connectors (similar to telephone connectors).

In an office, where reliability is more important, the 10BaseT network is often used. It's advantage is that one faulty cable, say from one user to the hub, doesn't bring the whole network down. Only the user with the faulty cable will be affected.

A look at the diagram for 10Base2 (Fig.1) shows why a single break in the cable can affect everyone on the network. Occasionally, users in each of the remaining segments of cable can "talk" to each other but the absence of a terminator at one end of the cable segment makes this very unlikely.

If you do decide to use 10Base2, look for a "combo" network card. These have both 10BaseT and 10Base2 connectors. This will allow you to change to a 10BaseT network later on,

Table 1: 10Base2 vs. 10BaseT

10Base2		10BaseT	
Advantages	**Disadvantages**	**Advantages**	**Disadvantages**
Generally cheaper to set up.	A cable break anywhere generally brings down the whole network.	More reliable - a break in a cable affects only one user.	More expensive because a central hub is needed to connect all users.
Ideal for use where users are spread out in a line.	Inconvenient to install where users are in a "star" arrangement.	Ideal for use where users are clustered together in one area and the hub can be centrally located.	Messy and expensive to cable where the users are all located in a long line.
	Slower than 10BaseT, since network cards are limited to half-duplex operation.	Faster than 10Base2 since the network cards can use full duplex operation.	

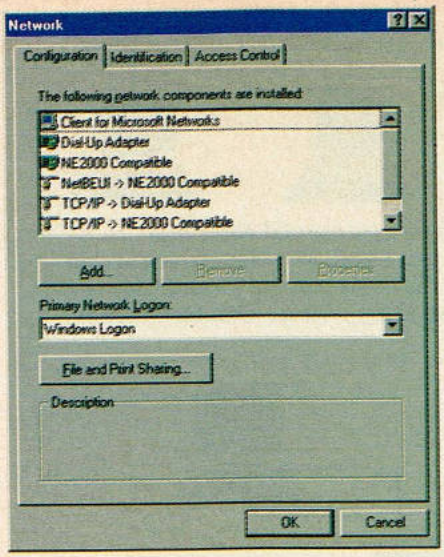


Fig.3: check this dialog box to ensure that the TCP/IP protocol is installed for your network card (not just for a DialUp Adapter). If it hasn't been installed, follow the procedure in the text.

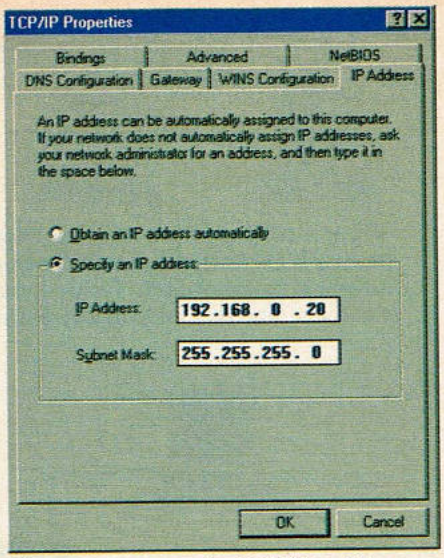


Fig.4: you set up the TCP/IP addresses using this dialog box. Each computer on the network must have its own address and these must also be entered in a simple text file named LMHOSTS – see text.

if you wish to expand the network. In fact, it's difficult to buy straight 10Base2 network cards these days.

PCMCIA cards for laptops tend to be a rather expensive. However, you should be able to get a reasonable PCI or ISA combo network card for less than $40.00

NOS: Network Operating System

Prior to Windows for Workgroups 3.11, you didn't have too many choices when it came to the network operating system (NOS). You either used Lantastic or Novell Personal Netware for a "peer-to-peer" system, or you used a Novell server in a client/server arrangement. None of these choices were cheap and nor were they all that easy to set up.

This situation changed with Windows for Workgroups 3.11, which featured an inbuilt peer-to-peer network operating system (NOS). Windows 95/98 and Windows NT also include built-in networking capabilities.

Network protocols

Usually, you would set up a small network using either the NetBEUI or IPX/SPX protocols. Indeed, if you intend using your old PC up as a file server, print server and/or a fax server, these network protocols are likely all you'll need.

On the other hand, if you'd like to set up your own intranet and experiment with a web server, then you will have to use the TCP/IP networking protocol. In case you're wondering, TCP/IP stands for "Transmission Control Protocol/Internet Protocol" and was originally devised by Novell.

Although it might initially appear rather mysterious, TCP/IP isn't all that hard to get going. The first step is to install the networking protocol and you do that via the Network applet in Control Panel. The procedure is as follows: load the applet, click the Add button, select Protocol, click Add again, select Microsoft, select TCP/IP and click OK – see Fig.3.

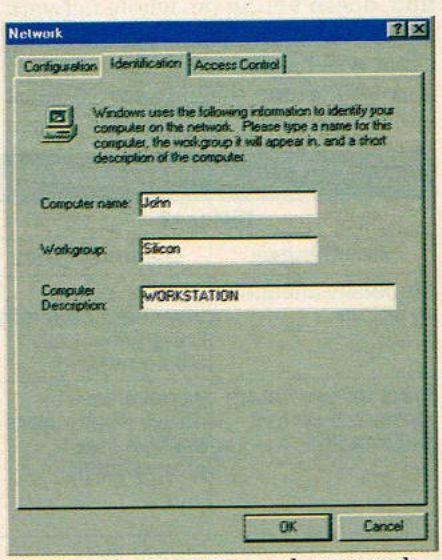


Fig.5: each computer on the network must be given a unique Computer name but all machines must have the same Workgroup name.

Once you have installed the networking protocol(s), select the TCP/IP protocol for your network card (at the Configuration tab of the Network applet) and click the Properties button. You can now set up your IP address, as shown in Fig.4.

Note that the IP address set here is "bound" to the LAN card and is non-routable. In other words, it is purposely selected so that it is ignored if you connect to the real Internet, in the outside world.

IP addresses

How do you know which number you can use. Well, the Internet Assigned Numbers Authority (IANA) has reserved the following three blocks of the IP address space for "private internets" (ie, intranets):

(1) 10.0.0.0 to 10.255.255.255
(2) 172.16.0.0 to 172.31.255.255
(3) 192.168.0.0 to 192.168.255.255

For this and further details on IP addressing, see reference document RFC1918 at:
http://ucnet.canberra.edu.au/RFC/rfc/rfc1918.html

The special IP address 127.0.0.1 refers to the PC itself. This is useful to know in some cases; eg, if you have a program that uses TCP/IP to "talk" to another program on the same PC.

Because these TCP/IP addresses are non-routable, it means that the Internet can not normally "see" past the PC that has the modem. In other words, it cannot "see" the other computers on the network (unless you have special software acting as a go-between). Nor can the rest of your intranet normally access the Internet through the PC with the modem.

Of course, there are ways to provide this access and this involves using a "gateway" or "router".

Identification

Having set up the IP addresses, you need to uniquely identify each computer on the network. You do that by clicking the Identification tab at Fig.3 to bring up the dialog box shown in Fig.5. Each computer must be given a unique "Computer name" but the same Workgroup name must be used for all machines on the network.

Having done this, click the "File and Print Sharing" button and select

Fig.5: Example LMHOSTS File

```
192.168.0.10    Anne
192.168.0.20    John
192.168.0.30    Server
192.168.0.40    Workstation
```

whether you wish to share your files and/or a printer.

Road maps for TCP/IP: LMHOSTS & DNS

In simple terms, packets of information sent via the Internet using TCP/IP find their way around using a Domain Name Server (DNS). These are like road maps.

Usually, it's not worth the trouble setting up a DNS to translate names to IP addresses for a small intranet (and in any case, you need NT Server). Instead, on a small network, IP addresses are best allocated using a simple text file called LMHOSTS. On large networks with NT Server, you can use WINS or DHCP.

The LMHOSTS file contains a list of the names of the various PCs on the intranet and their corresponding IP addresses. A sample file called LMHOSTS.SAM should be in the C:\WINDOWS directory. You simply copy this to the filename LMHOSTS in the same directory, strip out the comments (for speed of access by the PC) and edit it to include the details of the PCs in your system.

When the PC is restarted, your software will be able to "see" other PCs on the network (programs permitting) which use the TCP/IP protocol.

The accompanying panel (Fig.6) shows an example LMHOSTS text file after editing. Note that the various names must agree with the names assigned to each computer – see Fig.5.

Having set up your TCP/IP network, you can put it to work. Let's take a closer look at some of the more useful functions.

File server

It is much simpler to back up one directory than many directories on different PCs. Storing your documents on a shared directory on a network drive means that you need only back up one directory branch to save copies of everyone's work.

If you have invested in a ZIP drive or CD-ROM writer, this can be centrally placed to allow easy backup and access.

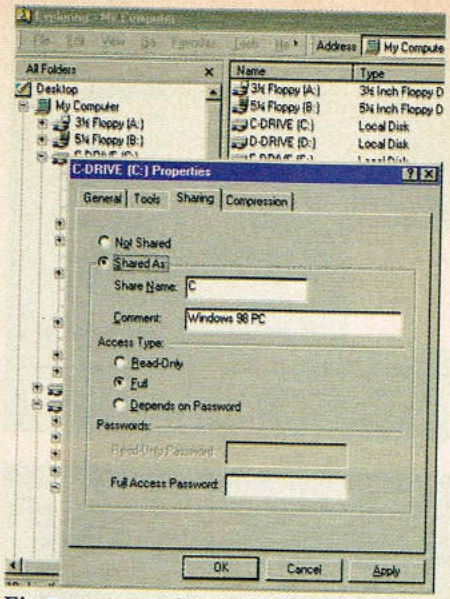


Fig.7: you can share a drive (or folder) by right clicking it in the Explorer, then clicking the Sharing option from the drop-down list and selecting the various options in this dialog box.

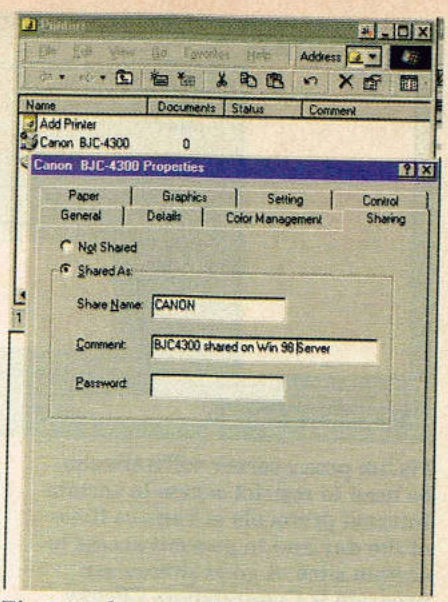


Fig.8: to share a printer, double click printers in My Computer or in the Control Panel (of the print server), right click the printer and select the Sharing tab.

To share a drive, right click it in the Explorer (or in My Computer), click Sharing and click the "Shared As" option – see Fig.7. Type in the share name in the space provided, then click "Full" for the Access Type. You can also set a password if you wish but don't do this unless necessary because it can be a nuisance.

Print server

Sharing a printer is just as easy as sharing files across the network. Under Windows 95 or 98, on the printer "server", click Start, Settings, Control Panel, then double click Printers. Now right click the printer, select the Sharing tab and you're all but there – see Fig.8.

Shared modem access

Unfortunately, sharing a modem (eg, for bulletin board access) is not something that's built into Windows for Workgroups 3.11, Windows 95 or Windows 98. You will need to get a third party product, such as I-Share from Artisoft, if you wish to share a modem across the network.

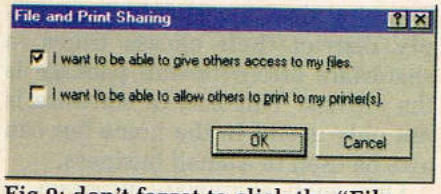

File and Print Sharing
I want to be able to give others access to my files.
I want to be able to allow others to print to my printer(s).
OK
Cancel

Fig.9: don't forget to click the "File and Print Sharing" button so that you can share your files and/or printers.

Shared Internet access

Unfortunately, you also need extra software to provide shared Internet access across a network using one dial-up modem – unless you have one of the big guns, that is (eg, Windows NT4 Server or Microsoft Proxy Server 2.0). However, this isn't difficult if you have the right program.

There are a number of commercial packages for Windows and these fall into one of two categories. Some programs simply act as "routers", re-routing Internet traffic appropriately. Others have a complete firewall system built in, including password access, and may even include a "proxy server" to cache web pages already recently accessed. A proxy server saves time and money when browsing the Internet.

In an office or home, you might like to restrict the websites that are available to different users. Some cheap shareware packages even allow you to restrict the type of access – eg, allowing email access only, with full access from 4-5pm daily.

Intranet web server

Why on Earth would you want your own web server and web pages, on

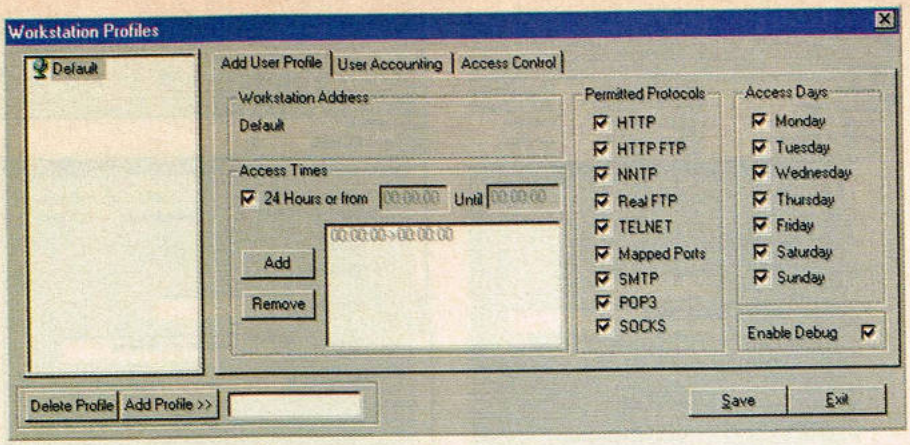
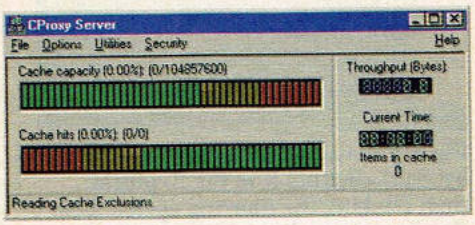


Fig.10: proxy server software can be used to restrict access to certain Internet protocols at various times of the day and to prevent access to certain sites. A good shareware program is Computalynx CProxy V3.1 which comes with a timer, allowing you to try it before deciding to buy.



your own LAN as part of an intranet? Well, an intranet can have many advantages, particularly in large organisations that need to disseminate data.

An Intranet is basically a cutdown version of the Internet and you can duplicate many of its functions. If you wish to develop web pages at home, for practice, fun or profit, you can easily set up a server using Microsoft's Personal Web Server software. This is supplied with the Front-Page 98 package and can run under Windows 95/98, handling up to 30 simultaneous requests.

Users of Windows 95 can use the Windows NT Option Pack 4 (yes the NT option pack), provided it's the Windows 95 version. There are three versions – one for NT 4 Server, one for NT4 Workstation and one for Windows 95. This option pack is available from http://backoffice.microsoft.com/downtrial/default.asp by following the links.

Windows 98 users will find this software on the Windows 98 CD-ROM in the \ADD-ONS\PWS directory. This latest Personal Web Server also supports .asp web pages (Active server Pages), thereby providing an ideal place to test out web site designs without going to the expense of a full-blown Windows NT 4 Server and Web Server system.

A number of other shareware or freeware web servers are also available. Check out the following two web sites for just a few of the many programs that can be downloaded:

(1) http://www.winfiles.com
(2) http://www.download.com

If you are looking for a fully-featured web server, take a look at O'Reilly's Web Site Pro – see http://www.ora.com. This excellent web server also features support for Active Server Pages (.asp). A mature open standard, .asp web pages allow server-side scripting which can be very useful. As an example, it can allow your site to extract data, on the fly, from an ODBC data source and make up the new web page as it goes.

With your own web server you can easily put confidential company information online internally for sales or other support staff. With .asp web pages, it's possible to read and write to database files and even create an accounts system, all through web pages displayed on standard web browsers.

Proxy servers and safe browsing for kids

If you want to stop the kids from browsing sites they shouldn't or simply restrict their access times, a shareware proxy/firewall package is the answer. This sort of software is not only useful in the home but can also be used in a small business.

One such shareware program is Computalynx CProxy V3.1 which comes with a timer, allowing you to try it before deciding to buy. This program features proxy caching of web pages, a firewall option and the ability to create user profiles. This last feature can be used to prevent users on one PC from accessing certain Internet protocols at various times, while giving complete access from another PC.

CProxy is available for download from www.computalynx.co.uk or from www.winfiles.com/apps/98/servers-proxy.html. You will also find dozens of other routers and proxy servers at the latter site.

Mail gateways

Another useful function to add into your server might be a mail server or mail gateway. Again there are a number of shareware options available. You will need to consider how you will handle multiple user names or if you wish to stay with the one username (usually your account name).

For example, let's say that John Smith and Jane Smith would like to have their email delivered under their own names. To do this, you could arrange to have two separate dial-up accounts, with each person independently logging onto the ISP (eg, as johns@xyz.com.au and janes@xyz.com.au). However, this requires two separate calls and will attract two account fees as well.

A better scheme, if your ISP allows it, is to have one log-on account (eg, smith@xyz.com.au) but then have separate mail accounts (johns@xyz.com.au and janes@xyz.com.au as before). Depending on the ISP, this shouldn't cost much more that the normal charge.

By using an email program that lets you set up multiple accounts, you can easily check both accounts with just one phone call.

Another approach is to set up a permanent Internet feed for your server. Your server could then receive email direct instead of it going via your ISP. To do this you would have to register a suitable domain name (eg, smith.com.au) and arrange for a permanent connection, either phone or ISDN, to your ISP. Your ISP would then change their MX record (a mail exchange pointer) to redirect incoming mail to your mail server, instead of it going to their mail server for later download. SC

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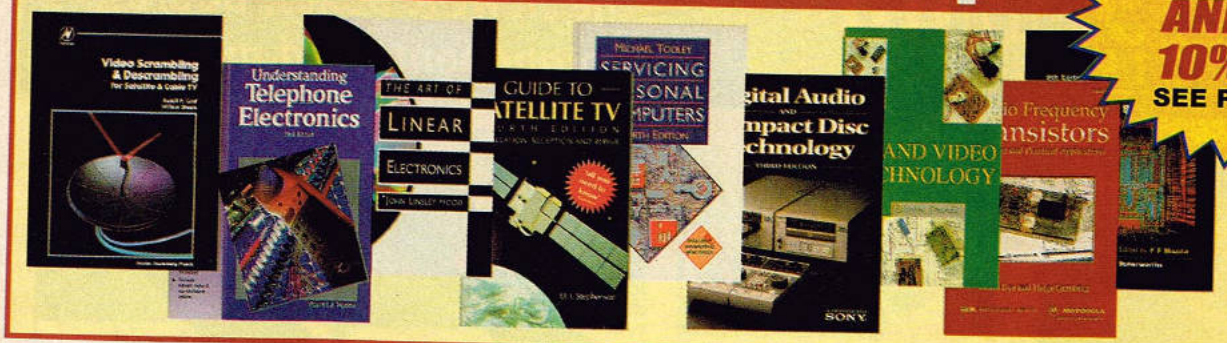

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By John Linsley Hood. Published 1993.

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By Stephen J. Bigelow. Third edition published 1997 by Butterworth-Heinemann.

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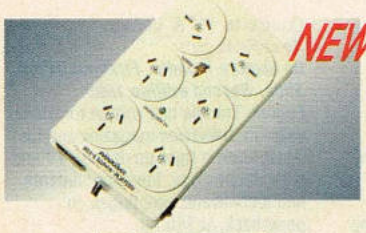

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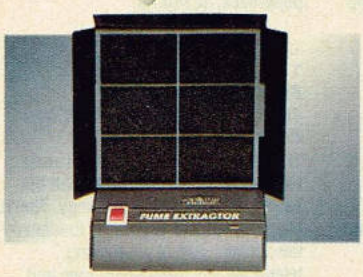

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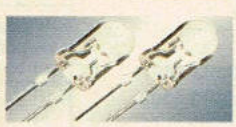

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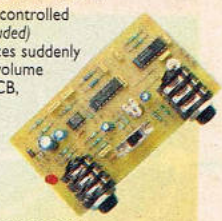

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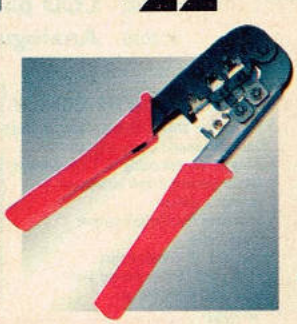

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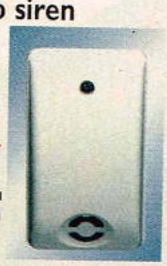

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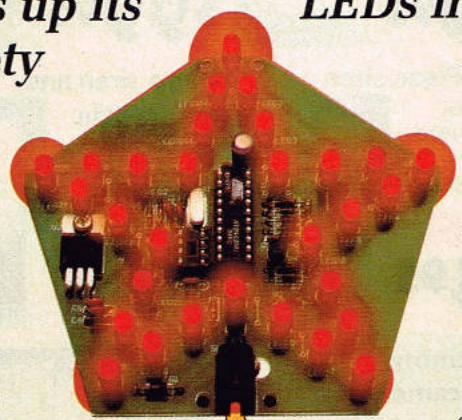
That's where you go!

The Christmas Star

What's this? A Christmas project in November? Well, we were so taken with this cute little project that we just had to run it this month so that readers would have plenty of time to build it for Christmas. It's a Christmas "star" which lights up its LEDs in a seemingly endless variety of patterns. Build it to add that "something different" to your Christmas tree. Or put it in the front window to impress the neighbours!



The PC board has just one IC to drive 30 LEDs which are arrayed in a five-pointed star. But we can't show you what the star looks like since the LEDs constantly flash in lots of different ways.

Sometimes the LED "points" of the star will flash, then they will rotate, then reverse direction, then the whole star lights up from the centre outwards and so on.

The circuit uses just one IC and yet the range of flashing patterns seems endless, although it does actually repeat the sequence after a minute or so.

With such a simple circuit producing such a variety of patterns the conclusion is inevitable. Yes, the IC is a microprocessor otherwise it would not be able to produce such a huge variety.

The PC board is five-sided and is quite small, suitable for mounting at the top of your Christmas tree if you want. It is powered by a 9V DC plugpack and has an onboard 5V regulator.

The microprocessor is an Atmel AT89C2051, a relatively recent derivative of the very common 8051. It comes in a 20-pin plastic package and contains 2K bytes of program memory, 128 bytes of RAM, 15 programmable I/O lines, on-chip oscillator, two 16-bit counter/timers, six interrupt sources and a full duplex serial port (UART).

This all sounds very much like a small 8051 until we add that the program memory is reprogrammable Flash with 1000 erase/write cycles, the oscillator runs to 24MHz (double that of the original 8051), the I/O pins can sink 20mA for directly driving LEDs and two I/O pins are connected to an on-chip analog comparator.

In other words, it is a somewhat souped-up 8051 and it can drive the LEDs direct, without any other circuit components.

This project started just before last Christmas when my daughters asked "Why don't we have any flashing Christmas tree lights?"

So, while they were out shopping, my son and I grabbed a dozen LEDs, some ribbon cable and a microcontroller. While my son wired up the LEDs, I wrote some simple software. It was all installed and running when they came home after spending all my money. That's why we didn't have lights before... The smiles on their faces made it all worthwhile!

I then resolved to do

by LES GRANT*

something better for this coming Christmas. And here is the result.

Why use a Microcontroller?

Using a PC's parallel port to control external devices is a popular approach these days but I certainly couldn't afford to tie up a PC for the few weeks leading up to Christmas just to flash a few LEDs; just think of the power bill to run a few LEDs in this way!

So, why not use a small microcontroller? They are cheap and easy to use and if the design doesn't work first time, you simply re-program it. So that is what I did.

As already mentioned, the hardware is the Atmel '2051 micro. To make it start thinking, we need a reset circuit and this simply consists of the 10µF capacitor (C7) connected to pin 1. The reset function works because the capacitor briefly holds pin 1 high when power is first applied. Then the capacitor charges up and this causes pin 1 to be pulled to 0V.

When the power is switched off, diode D2 forces this capacitor to discharge quickly, ready for the next time power is applied.

To set how fast the micro thinks, we need a 12MHz crystal X1 (in fact we used 11.0592MHz) and associated capacitors C1 and C2, connected to pins 4 & 5. Note that the crystal could be replaced by a 12MHz ceramic resonator. This allows the '2051 to execute an instruction every 1 or 2µs.

As you can see from the circuit of Fig.1, the 30 LEDs are connected in an X-Y matrix. Why 30 LEDs? Engineering is full of trade-offs or compromises. I wanted a 5-pointed star so the number had to be divisible by 5. For aesthetic reasons, we need an even number of LEDs per point. Six LEDs per point looked "about right". The next step up would have been 40 LEDs which would have required 13 I/O pins to drive them and a more complicated PC board.

We can drive 30 LEDs from only 11 I/O pins using a process called multiplexing. The appropriate combination of LEDs in a column is switched on for a short time (about 2ms in this case). This process is repeated for each column in turn, taking 10ms for a full cycle.

Provided the multiplexing is done quickly enough, the persistence of the human eye "fills in the gaps" and we see any combination of LEDs on without any flicker. The minimum practical multiplexing frequency is about 100Hz which is the frequency used by the star.

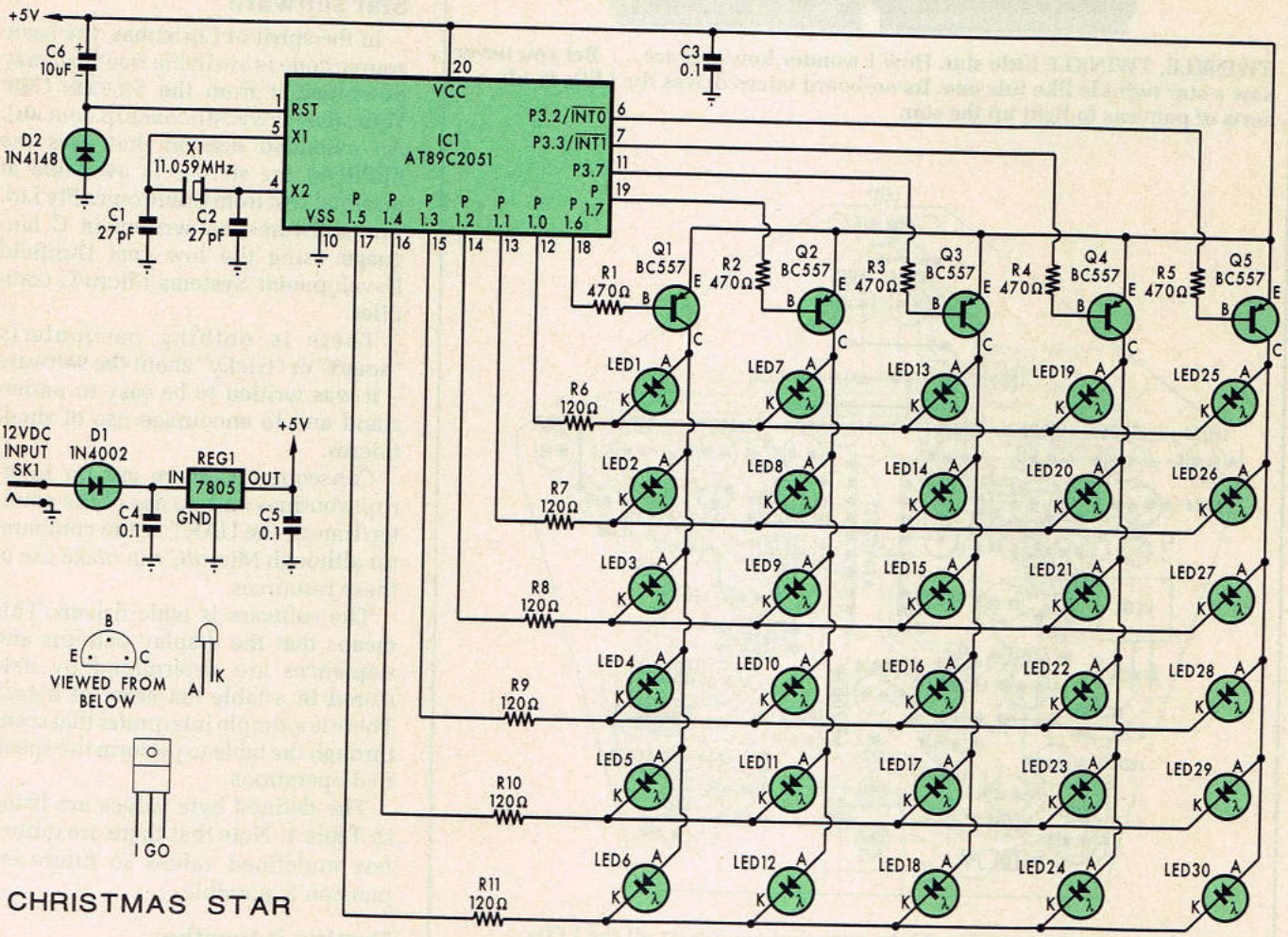
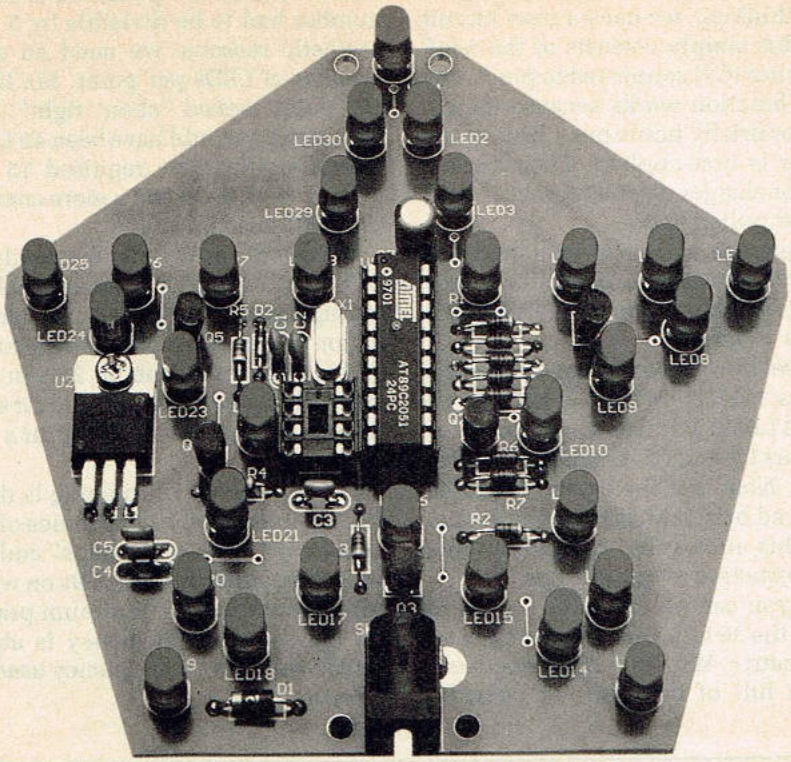


Fig.1: the micro drives the 30 LEDs in 5 x 6 matrix, with 5 colums and 6 rows. There is provision for an optional EEPROM which will store extra patterns in the future.



TWINKLE, TWINKLE little star. How I wonder how you are. . . Bet you never saw a star twinkle like this one. Its on-board micro drives the LEDs in all sorts of patterns to light up the star.

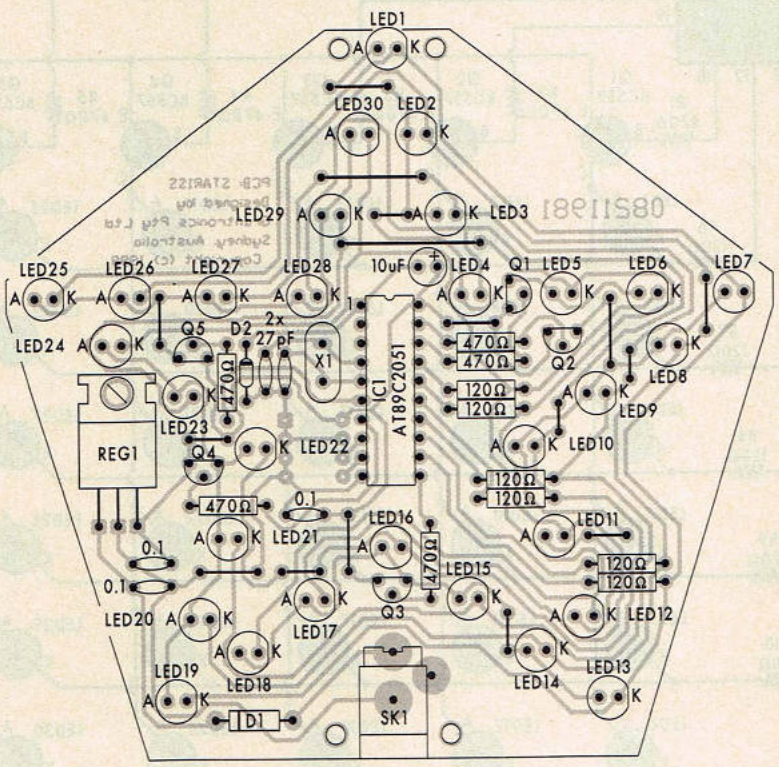


Fig.2: the component overlay, Make sure that you insert all the LEDs correctly: the cathode, or flat side, is oriented to the right in all cases. Don't insert the micro until you've done a voltage check on the board (see text).

Ideally, the LEDs should be high brightness types for best effect and in an ideal world would be matched for brightness. Maybe that's going a tad too far . . .

The power supply uses the ubiquitous 7805 3-terminal regulator with 0.1µF bypass capacitors at its input and output. Diode D1 provides reverse polarity protection so that you can't blow up the circuit if the DC supply is connected the wrong way around.

The maximum current drawn by the star is about 150mA with all LEDs on but is less than about 50mA for most patterns.

The maximum temperature rise of the 7805 when the star is run from a typical 9V DC unregulated plug-pack is about 30°C which is quite acceptable. If run from a 12V DC unregulated plug-pack it gets warmer and therefore should be provided with a small heatsink.

Star software

In the spirit of Christmas, the basic source code is available free (you may download it from the SILICON CHIP Web site – www.siliconchip.com.au). An extended version that uses the EEPROM for storage is available at minimal cost from Grantronics Pty Ltd. The software was written in C language using the low cost Dunfield Development Systems Micro/C compiler.

There is nothing particularly "smart" or "tricky" about the software – it was written to be easy to understand and to encourage use of small micros.

Consequently, there are no interrupt routines and no use of the counter/timers, the UART or the comparator although Micro/C can make use of these resources.

The software is table driven. This means that the display patterns and sequences are determined by data stored in a table (an array of bytes). There is a simple interpreter that scans through the table to perform the specified operations.

The defined byte values are listed in Table 1. Note that there are quite a few undefined values so future expansion is possible.

Putting it together

Assembly is quite straight forward. You will need a soldering iron with a

TABLE 1

Byte value or range	Operation
01 to 30 (0x01 to 0x1e)	Turn on LED 1 to 30
33 to 62 (0x21 to 0x3e)	Turn off LED 1 to 30 (LED number = byte – 32)
64 (0x40)	Go back to byte after loop start
65 to 79 (0x41 to 0x4f)	Loop start, count = byte – 64
128 (0x80)	Delay (use last delay count), each count = 10ms
129 to 191 (0x81 to 0xbf)	Delay, count = byte – 128, each count = 10ms
253 (0xfd)	All LEDs on
254 (0xfe)	All LEDs off
255 (0xff)	End of table

fine tip, preferably temperature controlled to about 600°F or 320°C.

The first step is to carefully check for shorts between tracks and broken tracks. Fit the smallest parts first, the wire links, followed by the resistors and diodes.

Next, fit the crystal (or resonator) and an IC socket for the micro. Then install the transistors, capacitors and LEDs.

Pay particular attention to the orientation of the LEDs – they don't work when installed backwards! Finally, install the 3-terminal regulator and the 2.1mm DC power socket. Don't insert the micro into its socket just yet.

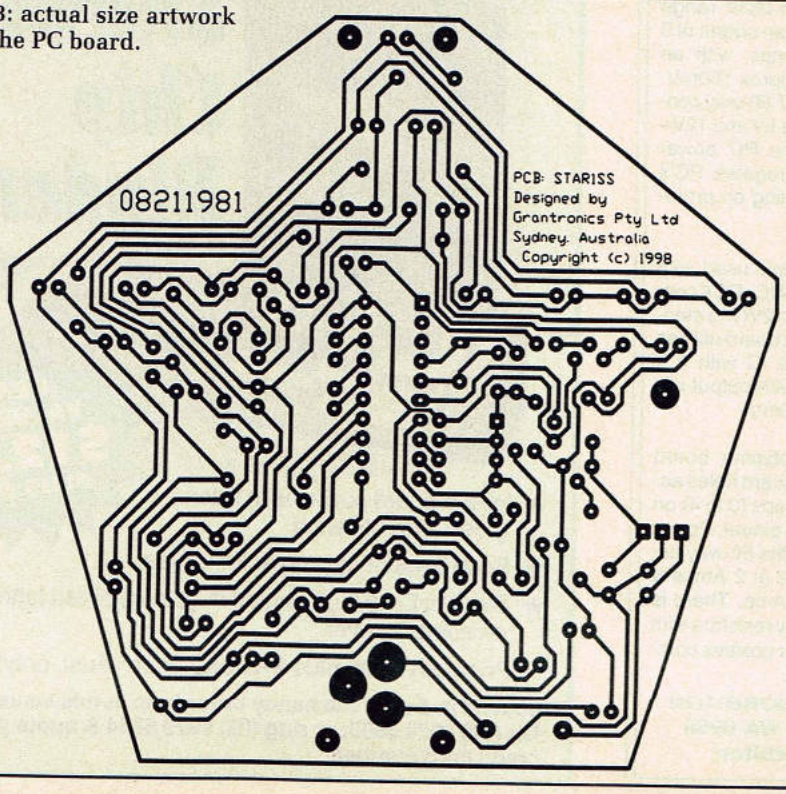
Do another close visual inspection, looking for solder bridges especially on the transistor pads. Then apply power and check for the presence of 5V between pin 20 (+) and pin 10 of the IC1 socket. If all is OK, remove power, plug in the micro (careful!) and apply power again. After a brief pause, the micro starts to do its thing and generates quite a range of patterns which then repeat after a while.

At the time of writing, the patterns weren't quite finalised but there is enough to entertain you. Everyone who saw the prototype thought that it was cute – or words to that effect.

The two holes in the board near LED1 may be used to hang the star and the holes near SK1 may be used to secure the plugpack's cable.

Finally, the appearance of the star may be enhanced by placing a piece

Fig.3: actual size artwork for the PC board.



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Parts List

1 5-sided PC board, code 08211981
1 2.1mm DC connector (SK1)
1 crystal or ceramic resonator, approx. 12MHz (X1)
1 20-pin IC socket
1 9V DC 150mA plugpack, Jaycar MP-3003 or equivalent

Semiconductors
1 AT89C2051 programmed microprocessor (IC1)
1 7805 regulator (REG1)
1 24C16 EEPROM (optional, enhanced version only)
30 red LEDs (LED1-LED30)
5 BC557 PNP transistor (Q1-Q5)
1 1N4002 power diode (D1)
1 1N4148 or 1N914 diode (D2)

Resistors (0.25W, 5%)
5 470Ω 6 120Ω

Capacitors
1 4.7µF 16VW electrolytic
3 0.1µF monolithic or MKT polyester
2 27pF ceramic

of red cellophane over the front.

Fault finding

If the 5V DC is not present, check the applied power polarity. The centre pin of the 2.1mm plug (SK1) must be positive. Check that D1 is correctly fitted. Check the tracks from SK1 via D1 and the 7805 to IC1 for breaks or shorts.

If one LED does not work, it may be inserted backwards or it may be shorted by a solder bridge between its pads. If one group of adjacent LEDs does not work, check the circuitry and soldering around the appropriate column drive transistor. If several individual LEDs do not work, check the corresponding row drive circuitry. Remember, faulty components are rare, soldering problems are common!

The future

The star is still evolving. That is part of the attraction of using a micro – it is so easy to change the behaviour by changing the software. And what about that optional EEPROM? Well, an enhanced version of the star will read its data from the EEPROM for much longer sequences. To check out the latest version of the software, log on to the Grantronics web-site at http://www.grantronics.com.au

If you don't have Internet access, send a stamped ($1) self-addressed envelope with an IBM format 3.5" disc to Grantronics and they will send you the current software files.

We hope you have as much fun building the star and playing with the software as I did creating it. Enjoy!

Where to buy a kit

We understand that the complete Christmas Star kit will be available from all Jaycar Electronics stores from this month for $29.95 **SC**

* Les Grant is the Engineering Director at Grantronics Pty Ltd, electronics design engineers. They can supply the programmed microprocessors for $10 plus $5 for packing and postage.
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NS_DC_DC is a step down converter with an input range 11 to 35V DC and an output of 5 volts DC at 5 Amps, with an output ripple of approx 150mV. There is an IN/OUT 50-way connector isolating the 5V and 12V+ &12V- rails of the PC power supply. This segregates PC's power when working on prototypes.

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NS_UTIL1 prototyping board has 1580 bread board holes access to any 3 groups (0 to 4) on the 50-way cable pinout. Power is available from the 50-way cable format 5 volts at 2 Amps & 12V+ 12V- at 1 Amp. There is provision for array resistors with either a ground or positive common connection.

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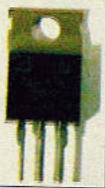

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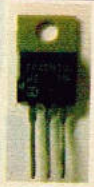

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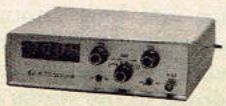

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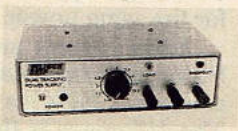

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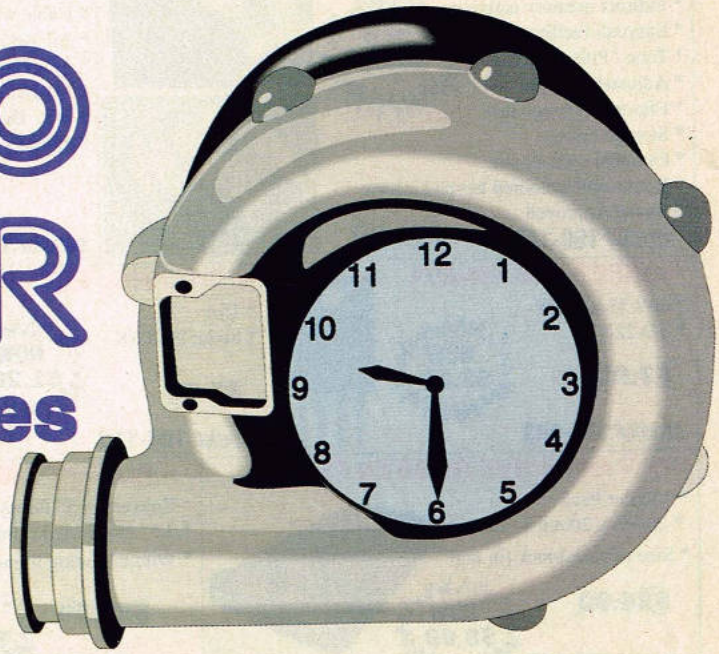


By John Clarke

Turbocharged engines have become very popular in recent years. Most car manufacturers have at least one turbo engine model in their range. Turbos aren't just for performance cars or four-wheel-drives, either: many a manufacturer has found that a turbo does wonders to tiny cars with tiny engines, turning them into the so-called "pocket rockets".

One big advantage of the turbo is that it can give a considerable performance advantage over the standard unboosted types without adding too much extra complexity.

Turbochargers work by directing the exhaust gas flow from the engine through a small turbine. This turbine in turn drives a compressor which boosts the atmospheric air pressure before it is applied to the inlet manifold of the engine. The resultant higher air density allows more fuel to be added prior to ignition, producing more engine power or more efficiency for the same power.

Turbochargers are often mistaken for superchargers (and vice versa) because they have the same basic effect. The difference is that a supercharger compressor is driven by a belt directly from the engine.

Turbos are usually lower in cost but can give the best of both worlds; heaps of power when you want it and fuel economy at other times. But the turbo must be allowed to cool down properly at the end of a trip before you switch the motor off.

Features

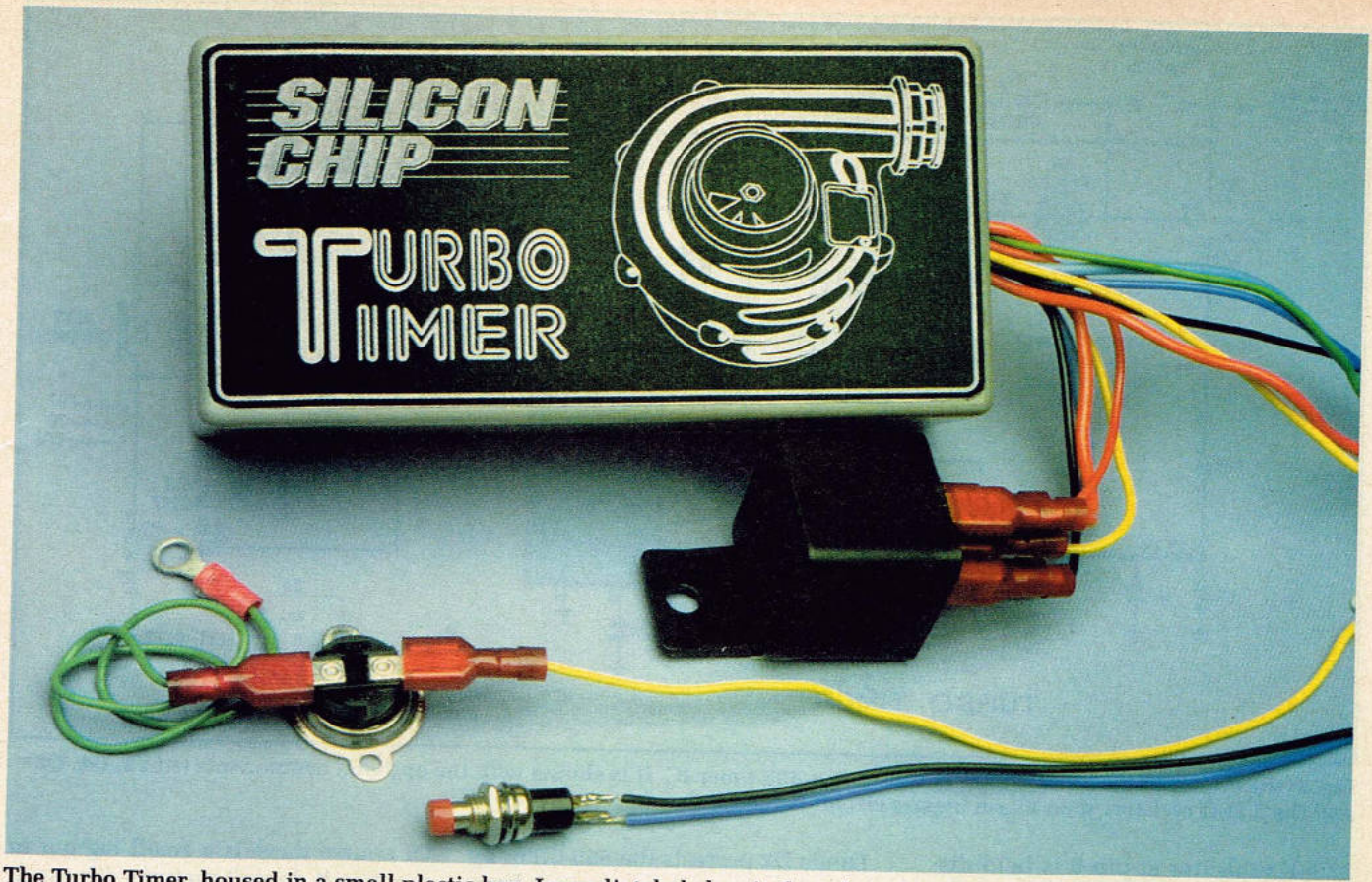
- Automatic operation
- 90 second timeout
- Under temperature disable
- Reset switch
- Ignition signal output for alarm
- Facility to override alarm systems which disable the ignition
- No battery power drain after timeout period

What happens is that the turbine in the turbo spins *very* fast in the hot exhaust gases (100,000 rpm is not unusual). An immense amount of heat is involved (it's not unusual for the inside of a turbo to glow bright cherry red!) and that heat can do a lot of damage if the turbo doesn't cool down before the oil flow to the bearings stops. Needless to say, when you turn off the engine the oil pump stops pumping and the oil stops flowing!

If this happens, the oil remaining in the bearings can be cooked. It carbonises, leaving gritty coke-like residue: just what you don't need in a high speed, high performance bearing!

What you *do* need is a way to keep the oil flowing after you've stopped the vehicle – and the only simple way to do that is to keep the engine idling for a minute or so.

This Turbo Timer does that job for you. You can lock up your car and walk away, safe in the knowledge that the Turbo Timer will run the engine for just long enough to safely cool down the turbo and then switch the engine off. And if you're only nipping down to the shops for a litre of milk,



The Turbo Timer, housed in a small plastic box. Immediately below is the relay which bypasses the ignition key switch, keeping the engine running for 90 seconds after switch off. Below that again are the thermistor and reset switch.

the Turbo Timer won't cut in: it will only operate after the engine has reached normal temperature.

The circuitry is dead simple: a 555 timer and one or two automotive relays do the job.

Automatic operation

Sitting in your car for a minute or two after stopping might sound easy but it's easy to forget; it's also easy to think "once won't hurt".

The SILICON CHIP Turbo Timer won't let you forget or miss out because if the engine is hot enough it will automatically keep running for 90 seconds or so after you switch off.

You can even alight from your car and switch on the alarm during this period in readiness to leave. Of course there are going to be times that you do not want or need the Turbo Timer facility and we have catered for this.

Firstly, the Turbo Timer does not operate until the engine has reached normal operating temperature. This is a fully automatic feature which requires no action on your part. It is useful if the car is just driven up the road and the engine has not had sufficient time to warm up. In this case the engine need not be run at idle to cool down the turbo bearings.

Another scenario happens where the engine has reached normal operating temperature but has not been working hard and where the turbo has not been in operation during your drive; for example during the slow trip to work in the morning where the engine hardly revs past idle. In this case we have provided a reset feature. You simply press the reset switch immediately after switching off the ignition and the engine will stop.

We have catered for alarm systems which may be triggered by the ignition being on during the time-out period. The Turbo Timer incorporates an ignition output which is disabled during the time-out period.

Also, some alarms disable the engine from operating by breaking the ignition circuit at some point or by shorting the coil. In either case there is the option to add a relay which counteracts these effects during the time-out period. The disabling feature of the alarm is regained after the time-out period.

The Turbo Timer electronics are housed in a small case, controlling a relay mounted outside the case. The relay contacts connect across the ignition switch to maintain ignition power during the time-out period. The relay is a heavy duty type specifically for automotive use: the contacts can handle up to 25A.

Circuit

The circuit for the Turbo Timer uses a single 555 timer, IC1, a transistor or two and a sprinkling of other components. The circuit is powered from the switched side of the ignition switch via diode D1 and a 33Ω resistor, giving an 11.4V supply rail from a nominal 12V car battery. The 16V zener protects against voltage surges while the 100µF capacitor smooths the supply and also maintains it for a short time when the ignition switch is turned off. This is important for correct circuit operation.

When IC1 is powered via the ignition and assuming the thermostat switch TH1 is open (pin 4 at 11.4V), the output at pin 3 is low and both transistors Q1 and Q2 are off. The

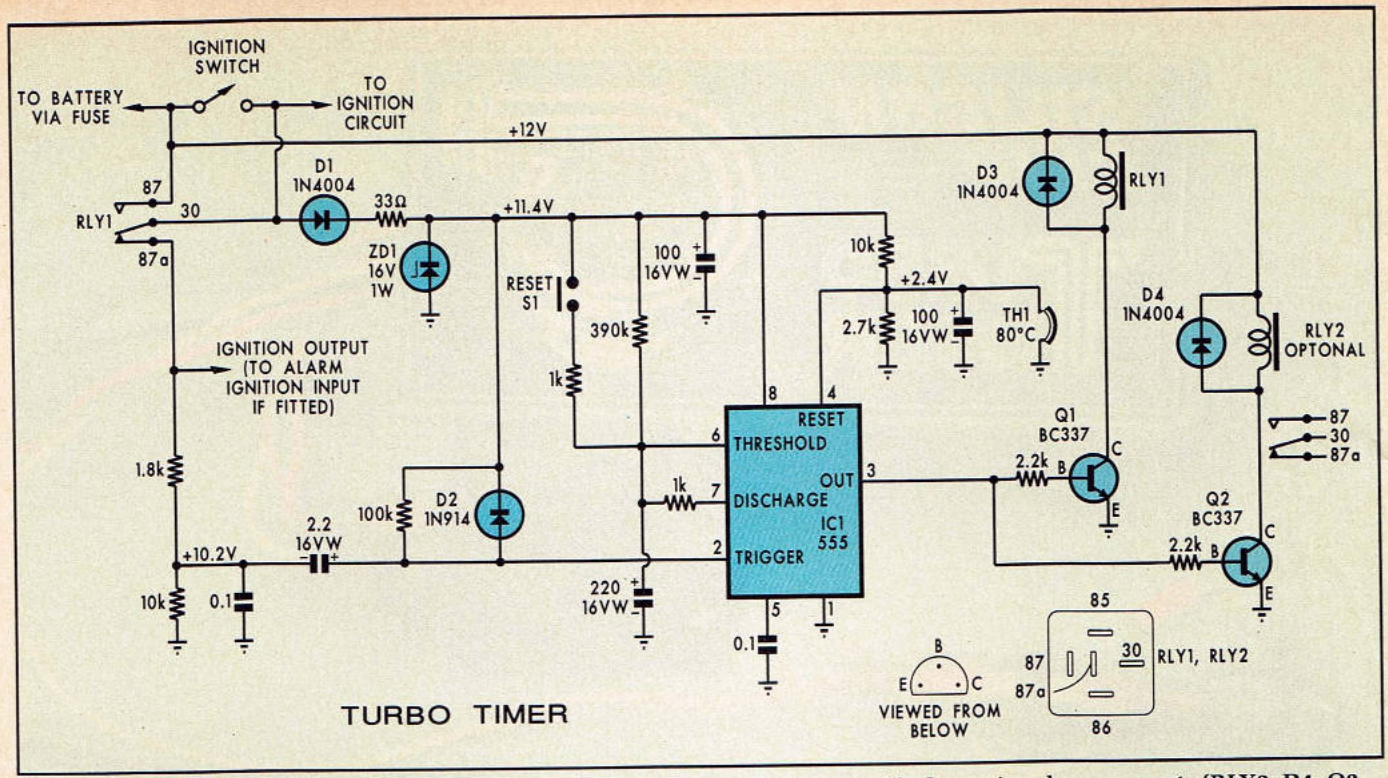


Fig. 1: the circuit of the Turbo Timer is based on a 555 timer IC. It is shown with the optional components (RLY2, D4, Q2 and the 2.2kΩ resistor) if an alarm bypass circuit is required.

220µF capacitor at pin 6 is held discharged via the 1kΩ resistor and the low state of pin 7. The trigger input (pin 2) is held high via the 100kΩ pullup resistor while the negative side of the 2.2µF capacitor is also pulled high via the normally closed contacts of RLY1 and the 1.8kΩ resistor.

When the ignition switch is opened (ie, the ignition key turned off), the negative side of the 2.2µF capacitor is pulled low via the 10kΩ resistor. The positive side of the capacitor follows this voltage down, triggering IC1 via pin 2. This releases the low on pin 7 to allow the 220µF capacitor at pin 6 to charge via the 390kΩ resistor. The now high pin 3 drives the base of Q1 and Q2 via 2.2kΩ resistors.

Transistor Q1 drives relay RLY1's coil and Q2 drives the optional RLY2, if fitted. RLY1's common and normally open contacts close, shorting the ignition switch. The normally closed contact is open and held low via the 10kΩ pull-down resistor. This contact can be used for an alarm system ignition input since it is low during this timeout period but follows the ignition supply at other times.

The 2.2µF capacitor at pin 2 now begins to charge up to the full supply voltage via the 100kΩ resistor and the 10kΩ resistor to ground.

Diode D2 protects the 555 timer by preventing the voltage at pin 2 from being elevated to unsafe levels, as could happen if the 2.2µF capacitor was fully charged and the relay contacts opened. This would lift the negative side of the 2.2µF capacitor to +10.2V, pushing the positive side to more than 21V, in all likelihood blowing the IC input. D2 also protects the IC from overvoltage caused by any spikes from the ignition system when the RLY1 normally closed and common contacts are connected.

The output at pin 3 ¹/remains high and the relay is held on via Q1 until the 220µF capacitor at pin 6 charges up to ²/₃ of the supply.

When this threshold is reached, pin 3 goes low, switching off transistor Q1 (and Q2 if fitted). The relay contacts of RLY1 revert to their normal position, cutting off the supply to the ignition circuit, stopping the engine.

At the same time, the 220µF capacitor is discharged via the 1kΩ resistor at pin 7. If the reset switch S1 is pressed during the charging period, the 220µF capacitor charges immediately via the 1kΩ resistor and the timing period ceases.

You may be concerned about any delay between turning the ignition key off and the relay contacts pulling in. Of course there is a small lag but in practice it doesn't matter – it's much quicker than turning your ignition key off and on again very quickly. The engine doesn't have time to stop.

Temperature detection

The thermostat (TH1) at pin 4 disables operation of the timer whenever it is closed. It is installed on the radiator of the vehicle so that it can monitor the engine temperature. When the radiator is cold, the thermostat contacts are closed and they hold the reset pin low. This stops pin 3 going high so the timeout does not operate.

When the radiator temperature reaches about 80°C, the thermostat opens and so pin 4 is pulled to 2.4V via the 10kΩ and 2.7kΩ voltage divider between the supply rail and ground. The circuit can now operate normally when triggered, with pin 3 going high for 90 seconds.

The 100µF capacitor at pin 4 is included to prevent IC1 from being triggered when the ignition is switched on and TH1 is open. The 2.7kΩ resistor ensures that the 100µF capacitor is fully discharged.

Relay 2

Relay 2 is included to enable the Turbo Timer to operate even if you

have an alarm system which disables the ignition system.

The relay contacts are changeover types so that you can make the required connection if the alarm system breaks the circuit or break the connection if the alarm applies a short to part of the ignition.

This relay (along with Q2 and its 2.2kΩ base resistor) is optional and need not be used even if you have an alarm of this type. It means, though, that the alarm cannot be set until after the turbo timeout period. Standing around waiting for the turbo timer to time out is about as convenient as sitting around waiting for a minute or so to turn the engine off – hence its inclusion for those vehicles fitted with ignition-disabling alarms!

Construction

Most parts for the Turbo Timer are mounted on a PC board coded 05411981 and measuring 104 x 58mm. The PC board can be housed in a suitable case measuring 130 x 68 x 41mm.

Alternatively, you can house the entire circuit in heatshrink tubing. The photographs show a plastic case but there are some security arguments for a metal (diecast) case; more on this subject shortly.

The PC board was sized to clip into the plastic catches on the side of the box. Make sure that it is of the correct width to fit snugly in position. Use a file to narrow down the PC board if it is too wide.

Begin construction by checking the PC board for shorts between tracks and possible breaks, then insert and solder in all the PC stakes.

The resistors can be installed next using the accompanying colour code table as a guide to selecting each value. Alternatively, you can use a digital multimeter to measure each value. If in any doubt as to a resistor's value, check it anyway.

Diodes can be mounted next, taking care with the polarity of each. Make sure that you use a 1N914 or 1N4148 type in the D2 position. ZD1 must be a zener diode; it may be marked 1N4745.

Take care of any polarity-conscious components: transistors Q1 & Q2 (which are positioned as shown with the curved side toward the edge of the PC board); IC1; the diodes (don't mix up the zener with the others) and the electroyltic capacitors

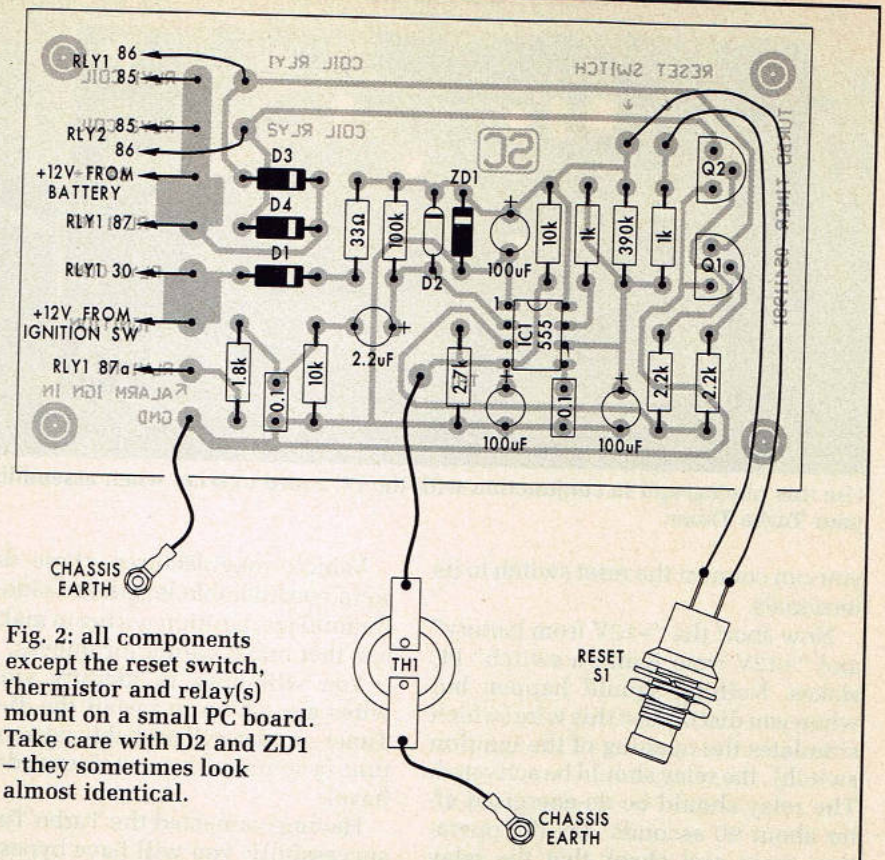


Fig. 2: all components except the reset switch, thermistor and relay(s) mount on a small PC board. Take care with D2 and ZD1 – they sometimes look almost identical.

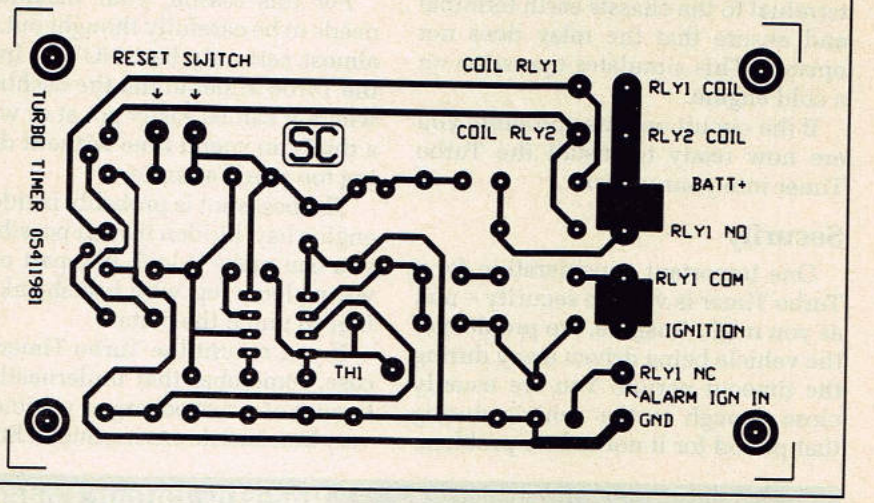


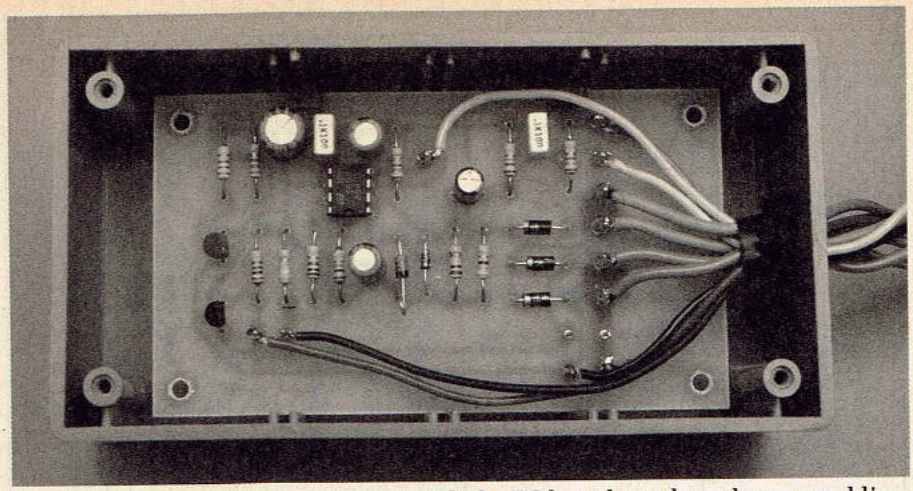
Fig. 3: this full-size PC board pattern can be used to etch your own board or used as a reference when checking a commercial or kit board.

We mounted our relay on the end of the case, but there is no necessity for it to be so mounted. If you mount yours on the end of the case, drill the case to accept the mounting bolt for the relay and about a 10mm hole for the wiring loom to exit.

Wiring

We used light duty wire for all wiring except for the wires to the ignition switch and wires connecting to terminals 87 and 30 of the relay. These must be wired with heavy duty automotive wiring. Use insulated crimp female spade connectors to connect to the relay terminals.

You can test the Turbo Timer using a 12V supply with a rating of at least 200mA. First connect the positive supply to "+12V from battery" and the negative to the "chassis earth" terminals on the PC board. Do not connect the TH1 thermostat at this stage but



Use this photograph in conjunction with the PC board overlay when assembling your Turbo Timer.

you can connect the reset switch to its terminals.

Now short the "+12V from battery" and "+12V from ignition switch" PC stakes. Nothing should happen but when you disconnect this wire (which simulates the opening of the ignition switch), the relay should be activated. The relay should be de-energised after about 90 seconds. Try the operation again and check that the relay drops out when the reset switch is pressed.

Temporarily short the thermistor terminal to the chassis earth terminal and ensure that the relay does not operate. This simulates operation on a cold engine.

If the circuit operates properly you are now ready to install the Turbo Timer into your vehicle.

Security

One important consideration for a Turbo Timer is vehicle security – not, as you might imagine, the problem of the vehicle being driven away during the timeout period. You are usually close enough to the vehicle during that period for it not to be a problem.

Vehicle manufacturers these days go to considerable lengths to hide, or camouflage, ignition wiring to make it just that much harder for thieves.

You will have to identify which wires are which to install the Turbo Timer – and it will probably take some time (a commodity most thieves don't have).

Having connected the Turbo Timer successfully, you will have bypassed a lot of that security and identified the two most sought-after connections (for a thief) – the ignition terminals.

For this reason, your installation needs to be carefully thought out. It is almost certainly best NOT to install the Turbo Timer under the dashboard where it can be easily got at or where a thief can spend time without drawing too much attention.

The best spot is probably inside the engine bay, hidden if at all possible. If you can make it look like part of the wiring loom (eg, with heatshrink tubing) so much the better.

If you mount the Turbo Timer in a case, remember that underneath the bonnet of a turbocharged vehicle is a very hot, hostile environment. Ensure that the case is mounted well away from the "hot" side of the engine and that a suitable case is used to prevent water ingress. In fact, we would prefer to see a metal diecast case used. Sure,

Parts List

1 PC board, code 05411981, 104 x 58mm
1 case, 130 x 68 x 41mm
1 20A 12V horn relay with change over contacts (RLY1)
1 80°C thermostat with normally closed contacts
1 normally open pushbutton switch (S1)
7 insulated 6mm female spade connectors
2 crimp eyelets
8 PC stakes

Semiconductors
1 555 timer (IC1)
2 BC337 NPN transistors (Q1,Q2)*
3 IN4004 1A diodes (D1,D3,D4)
1 1N914, 1N4148 diode (D2)
1 16V 1W zener diode (ZD1)

Capacitors
1 220µF 16VW PC electrolytic
2 100µF 16VW PC electrolytic
1 2.2µF 16VW PC electrolytic
2 0.1µF MKT polyester

Resistors (0.25W, 1%)

1 390kΩ	1 2.7kΩ	2 1kΩ
1 100kΩ	2 2.2kΩ*	1 33Ω
2 10kΩ	1 1.8kΩ	

Option
1 20A 12V horn relay with change-over contacts (RLY2)

Miscellaneous
Automotive connectors, Automotive wire, solder, etc.

* Q2 and one 2.2k resistor are also optional if RLY2 is not fitted

Resistor Colour Codes

	No.	Value	4-Band Code (1%)	5-Band Code (1%)
❒	1	390kΩ	orange white yellow brown	orange white black orange brown
❒	1	100kΩ	brown black yellow brown	brown black black orange brown
❒	2	10kΩ	brown black orange brown	brown black black red brown
❒	1	2.7kΩ	red violet red brown	red violet black brown brown
❒	2	2.2kΩ	red red red brown	red red black brown brown
❒	1	1.8kΩ	brown grey red brown	brown grey black brown brown
❒	2	1kΩ	brown black red brown	brown black black brown brown
❒	1	33Ω	orange orange black brown	orange orange black gold brown

Fig. 4: full-size artwork for the label on the plastic box used for the prototype. This may need slight enlargement or reduction (eg by a photocopier) on a metal box.

they cost a few bob more – but what's your car worth?

Installation

Taking into account the above comments, find a suitable position for mounting the unit.

Locate the fused side of the ignition circuit and the fused side of the battery supply – you may need a workshop manual to help you with this because it is not normally something you'll find in an owner's manual.

In most vehicles, the fusebox is mounted under the dash. It's easy to check which connectors are fused using either a 12V test lamp or a multimeter – pull out the fuse and see if you still have voltage!

The ignition circuit is usually most easily accessed under the bonnet rather than under the dash. Most vehicles have the ignition fuse separately mounted under the bonnet.

The wiring to all points should be made using good quality automotive connectors.

You will also need a chassis point to connect the ground supply of the circuit to the battery negative terminal. This can be an existing screw in the metalwork or a separate self-tapping screw which secures the eyelet terminal for the ground lead in place. If mounting the relay externally you will also need to find a suitable screw – the mounting plate usually needs to be grounded.

If you are the only driver of the vehicle, it is better to mount the reset switch in a not-too-obvious position. If you have a dashboard with any spare switch mounting plates, you could use one of these. If others drive your vehicle, or if putting it in for service, let them know it has a Turbo Timer fitted and where the reset switch is!

The thermal cutout switch can be mounted on the radiator body but not on the cooling core. You may be able to secure it using some steel wire which wraps around one of the side chambers by passing it through the cooling fins. Make sure that the surfaces of both thermal switch and radiator are mating squarely.

A smear of heatsink compound between mating surfaces will ensure better thermal contact.

As an alternative, on a copper or brass radiator you could solder a couple of M3 nuts to the radiator body and secure the thermal switch to these using the integral mounting plate.

Otherwise, you may need to attach the thermal cutout to the radiator hose using tie wire, cable ties or similar.

One contact for the thermal switch connects to the Turbo Timer PC board while the second terminal connects to chassis near the radiator using a self-tapping screw to secure the eyelet.

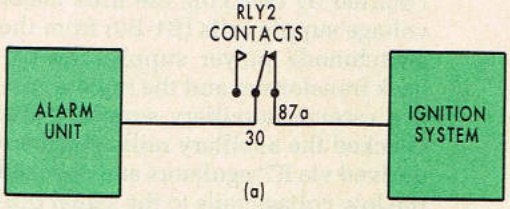
Incidentally, if you ever need to disable the Turbo Timer (eg, for vehicle service), shorting the two thermistor terminals together is the easiest way to do it.

You may wish to connect up the optional second relay (along with Q2 and its 2.2kΩ base resistor) if you have an alarm system installed. Note that you should use the ignition output on the Turbo Timer if the alarm monitors the ignition. Details of how to wire up the second relay are shown in Fig.5. There are two alternatives catered for in this wiring.

Firstly in Fig.5a, the wiring diagram shows how to wire the relay to counteract the alarm unit from shorting out the ignition.

Fig.5b shows how to counteract the alarm unit when it open circuits the ignition system. The normal alarm ignition disable feature will be maintained once the turbo timeout period has expired. Use heavy duty automotive wire for the connections.

If the 90 second delay is too short or too long, you can adjust it by varying the 390kΩ resistor between the positive supply and pin 6. Increasing the resistor will increase the time, decreasing it will (surprise!) decrease the timeout period. The 220uF capacitor could also be increased to 470uF for a longer period.



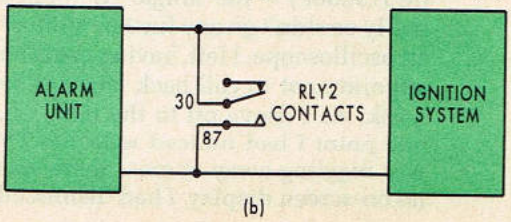


Fig. 5: if your alarm system disables the ignition by shorting it out, use option (a). If it open circuits the ignition system, use (b).

Using It

Operation is virtually foolproof: when you park the vehicle, ensure it is in "park" (auto transmission) or "neutral" (manual transmission), engage the handbrake fully, turn the ignition key off, remove it, get out and lock up. .

Note the comments above about setting your alarm, if you have one.

Finally, a warning: if leaving the car in an enclosed area (such as a home garage) beware of the carbon monoxide fumes which will be given off during the engine run-on period. Park the vehicle so that its exhaust is directed outside or leave the garage door open. Carbon monoxide is colourless, odourless . . . and poisonous. **SC**

SERVICEMAN'S LOG

Big tellys, PCs & car computers

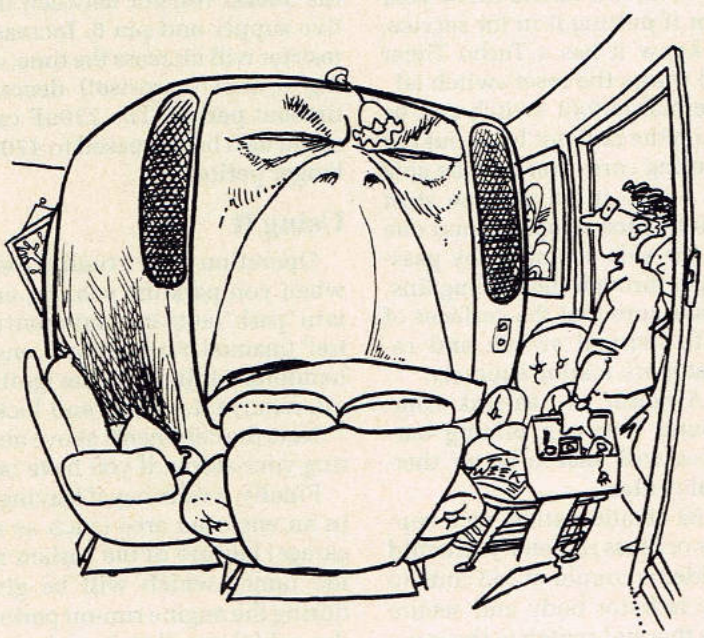
Why is it that all large-screen TV sets are located up flights of stairs, making it impractical to move them? I recently came across two such monsters, along with a PC that kept losing its icons. I also got tangled up with a couple of car computers.

It was with fear and anticipation that I set off to "look at" a large screen Sanyo TV, as Mrs Collins had begged me to. She was unable to tell me the model number as she could not get to the back of the set but she repeated that the fault was no picture. And because she was recuperating from an operation on her leg, she really needed to watch the telly.

When I arrived at the third storey unit, mentally noting that there was no elevator, I was surprised to find that her home was even smaller than I had imagined it to be. You couldn't miss the 78cm stereo TV as it took pride of place in the living room. The furniture was spread out in a semicircle around the set, as though it was praying to the craven idol.

How they got the set into this matchbox must be a story in itself but one thing was for sure – it was going to have to be fixed on location, as I certainly didn't have the facilities to take it to the workshop.

When I finally managed to move the set out a fraction from the wall and crawl behind it, I established that it was a Sanyo CPP3310TX-01 (A4-A33 chassis). Because of the restricted space, it took some effort to remove the back but this did little to make the access any easier. Secretly, I prayed to the Patron Saint of Television for a merciful and quick conclusion to this repair.



YOU COULDN'T MISS THE 78cm STEREO TV AS IT TOOK PRIDE OF PLACE IN THE LIVING ROOM...

I had already established that there was sound but no raster from any source – be it from the TV tuner or the AV inputs. Nor was there any Teletext on Channel 7. I propped up a large mirror in front of the TV so that I could monitor any activity from the rear and then turned up the screen control on the flyback transformer to produce a blank clear raster.

Well, the report card on the TV now showed me that almost all the circuits were working. However, the luminance and chrominance signals were disappearing somewhere between the video detector and the picture tube. And because there was no picture from the AV inputs, this meant that the problem could be shifted a little further away from the detector – possibly to the analog switching circuitry. Even so, it was looking more and more like a problem with the small-signal decoding stages and for this I needed a circuit diagram.

Mercifully, Mrs Collins had kept the one that came with the set and so I started by checking the nine major voltage supply rails (B1-B9) from the switchmode power supply, the flyback transformer and the remote control receiver auxiliary supply. I also checked the ancillary rails which are derived via IC regulators and checked the low voltage rails to the signal processing circuits but nothing was amiss.

By now, I was suspecting IC201 (M513086P) – the jungle IC – but I really couldn't go any further without an oscilloscope. I left, having made an appointment to call back later in the week. As I drove off to the next job, one point I had noticed with the TV was niggling away at me – there was no on-screen display. I had dismissed

this at the time but now I couldn't help feeling that I had been down this path before.

When I got back to the workshop, I phoned Sanyo Technical Support and they also (without prompting) suggested the jungle IC. They also advised me to check crystals X421 and X261. To save time, I ordered the IC just in case this was the problem.

I was back at Mrs Collin's little flat a few days later and this time there was even less room as I had brought an oscilloscope and a signal generator. Access to the underside of the main PC board was impossible and it wasn't much better for the top because the AV board got in the way. Because nothing could be seen on the screen, I couldn't tune the TV into the RF output of the pattern generator so I injected colour bars into the video input phono socket (AV1) instead.

It took me quite some time with the circuit to finally work out that the AV module not only selects the various sources but also splits up the video into chrominance and luminance signals. The latter then goes through a "video unit" which is a noise reducer circuit, before finally arriving at pin 18 of IC201. The CRO confirmed this and also that the crystals were oscillating with the remote control.

Next, I selected a channel number which had good sound before checking the video output from the IF pack on test point TP-J with the oscilloscope. The signal was there and also at IC201. Reselecting AV1, I then measured the colour difference output signals from IC201 on pins 1, 2 and 3 and was surprised to find them all there. I then followed these signals through the AV board "Super Imposer" (IC1307), which switches through the Teletext, and onto the CRT socket where the signal died after the emitter input to the output transistors.

It was then that the bells began ringing, because I had been here before with a very similar problem in a Palsonic 5138 TV set (see November 1997). Sure enough, here was the exact same component, namely a 120kΩ resistor (R692) feeding the base circuit of the video output transistors from the +200V rail. And once again, the high voltage had been too much for this low-wattage resistor and it had failed, switching off all three transistors.

If only I could remember all these

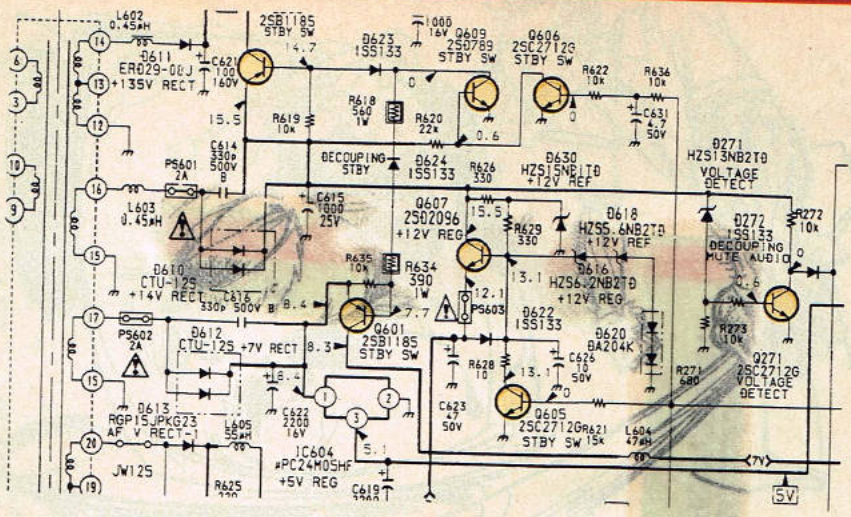


Fig.1: the standby switching circuitry in the Sony KV-C2931S. A break in the circuit between R634 and D624 meant that Q601 was being turned off but the fault was intermittent.

faults, although I'm sure I won't forget this one the third time around. Anyway, Mrs Collins was delighted and I was left with the challenge of disengaging myself from the tangle of equipment and getting out of that tiny flat in one piece.

Another monster

In the meantime, yet another house call was booked in for a large screen TV. Why is it that all the biggest sets are located in the most difficult positions – usually up flights of stairs with no lifts? Or is it just me being paranoid?

This time, the set was a 1990 Sony KV-C2931S, using an AE-1B chassis made in West Germany. The complaint was intermittent no sound or picture. Mr and Mrs Mowbray, who owned the set, were a retired couple living on the top floor of a duplex and had enough trouble getting up and down the stairs as it was, so they were in no position to assist me with the TV. Once again, it was a case of the workshop going to the TV rather than vice versa.

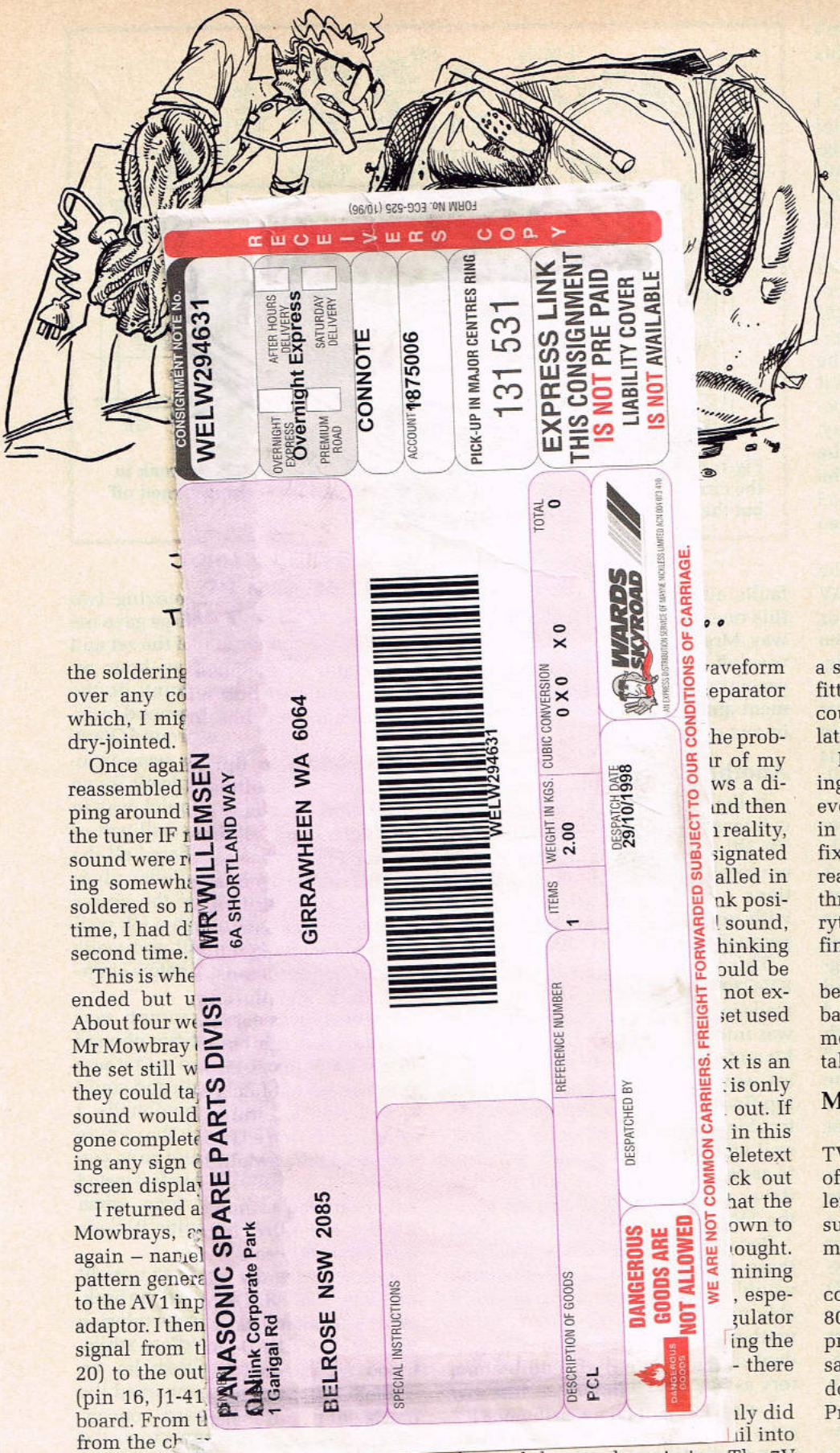
Because I had serviced so many of these sets, I thought that the fault would be easy to fix. It would probably turn out to be a dry joint on the motherboard and I was quite confident of an early and successful victory as I climbed the many stairs.

I arranged with the Mowbrays to get a blanket and cushions ready and then gently tilted the set over onto its front to rest on them (the cushions, not the Mowbrays). Removing two screws and a couple of clips gave me access to the underside of the set and I then spent over half an hour resoldering many suspect joints on the motherboard, especially around resistors R614 and R6[illegible]3 and around Q608.

Some of the d[illegible] joints were inaccessible under the black plastic frame and the only cheap and quick way to address these is to cut a small part of it away. Anyway, I resoldered all the transformers, transistors, diodes, plugs and sockets and some of the power ICs. Finally, satisfied with a job well done, I reassembled it all and made sure all was working well before confidently leaving.

Unfortunately, my triumph was short-lived – Mr Mowbray phoned about two weeks later and said it was doing the same thing again and could I please call back. Disappointedly, I returned, and sure enough the picture and sound would come and go as you tapped the set. Now I had in fact tested this thoroughly the last time, when tapping it or even thumping it made no difference.

This time I left the set in an upright position and gently removed the back, then tapped around the set exploring for more sensitive spots. After a while, I felt sure that the problem lay on tuner IF module A, so I reworked the soldering all over this board, concentrating on the edge connectors, the tuner and any coils. I then unsoldered the IF module (VIF901) and reworked



the soldering over any co which, I mig dry-jointed.

Once agai reassembled ping around the tuner IF r sound were r ing somewh soldered so n time, I had d second time.

This is whe ended but u About four we Mr Mowbray the set still w they could ta sound would gone complete ing any sign screen displa

I returned a Mowbrays, a again – nam pattern genera to the AV1 inp adaptor. I then signal from t 20) to the out (pin 16, J1-41 board. From t from the ch to the Teletext board (CNV-01 pin 3). But there was no video going into CNV-01 and I traced the line back to the collector of transistor Q601 (the standby switch) on the motherboard. There was 8.4V on its emitter (which is correct) but this same voltage was also present on the base, thus completely switching the PNP transistor off.

Q601's base is controlled by transistors Q606 and Q609 via R634, D624 and R618 – see Fig.1. There should have been 0V on Q609's collector and this proved to be the case. There was also 0V present on the cathode of D624 but R634, which is connected directly to it, measured 8.4V. This meant that there had to be a break in the board track between D624 and R634, although the track looked perfectly OK.

This track, by the way, is only about 25mm long and passes next to a hole drilled through the board. This might have been a screw hole but there was no screw fitted – maybe it was only used in the course of manufacture and discarded later.

I scratched away the lacquer covering the track and, using an ohmmeter, eventually found a hairline fracture in the copper. Resoldering the crack fixed the problem and I carefully reassembled the set. A check some three months later revealed that everything was still OK, so I think I've finally fixed the monster.

If I'm wrong, I'm returning with my best fine-tuning tool – my baseball bat. John Cleese will have nothing on me after I've given that set a stern talking to.

Missing icons

In addition to the usual VCRs and TV sets that come my way, I'm also often confronted with computer problems. Some of these can be quite unusual and I have one such story this month.

The first was a 1994 ICL ErgoLite computer, which is actually an Acer 80486 DX-50 in disguise. Its main problem was that it was unable to save any setting made within Windows 3.11 on exit, resulting in a blank Program Manager with no icons.

At first, I thought that this would be a case of simply reloading Windows over the top of the existing installa-

tion but this didn't help. I then spent some time reloading DOS 6.22 and customising its config.sys and autoexec.bat files to optimise memory but that didn't help either. I then ran Scandisk, a virus checker and defragged the drive but I wasn't getting anywhere. The resources were fine and the computer hardware was fine too.

My next step was to examine system.ini and win.ini but again I could find nothing untoward. What finally put me onto the right track was thinking more carefully about what was actually happening and especially why the icons were disappearing (very Agatha Christie).

This part of the operating system is controlled by Progman.exe and customised with Progman.ini. Using my trusty XTree Gold (the one and only), I examined Progman.ini and compared it with the Progman.ini from another computer that worked. Normally, this text file has two headings, [Settings] and [Groups], the former giving details as to how the groups are arranged and the latter describing what the groups actually are. However, on the faulty computer there were two or three lines of machine code and then the settings and codes were repeated about half a dozen times, often with conflicting information.

At last I was getting somewhere. Hopefully, all I would have to do is edit the Progman.ini file but first I went to the Windows directory and printed out a list of all the group files (*.grp) for use as a reference. After that, I backed up Progman.ini and then edited the file by removing all the machine code and then listing all the Group files under the [Group] heading. Finally, I edited the lines under the [Setting] heading, removing any duplicates in the process, and re-saved the file.

This simple measure completely fixed the problem. The next time I went back into Windows, all the icons were there – indeed there were even some duplicates. A little extra housework made everything shipshape and the program groups now remained in place each time I exited and rebooted Windows.

My guess is that the problem had been caused by the computer being turned off (or crashing) while Windows was still running. This had created lost clusters and chains which had been repaired as best as possible by Scandisk. Unfortunately, the Progman.ini file had been corrupted and could only be manually repaired using the method just described.

The moral of the story is to always exit Windows properly before turning the computer off.

Car computers

My final two stories for this month are also about computers but this time, they involve car computers. So how did I come to get involved in car computers? Simple – a mate of mine runs an automotive workshop.

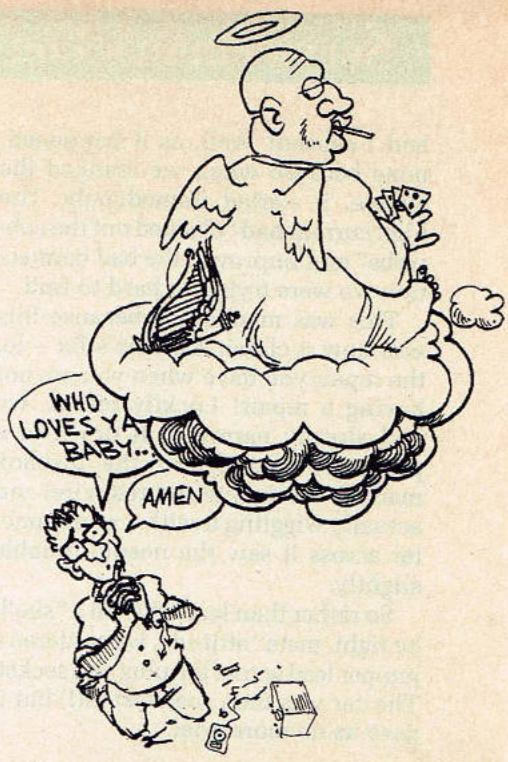
The first story is about a Eunos that wouldn't start, although we were pretty sure that it wasn't the computer itself that was at fault because a substitute didn't fix the problem. The car would crank and there was spark but no injector pulses. Based on this, we deduced that the problem probably lay somewhere between the computer and the fuel injectors but there were a few other possibilities. With amazing luck, we actually managed to obtain a photocopy of the wiring diagram for the car but not of the computer itself, unfortunately.

We began by using a multimeter to establish that 12V was getting to the computer and to the injectors – and this proved to be the case. However, it was prophetically pointed out at the time that it isn't a good idea to use a multimeter in auto electrics, as the internal resistance is so high that it can give very misleading results. Instead, it is far better to use a 12V lamp probe but we couldn't find the workshop unit at first.

After these initial checks, I decided to use a CRO to check the input pulses from the two crank sensors (why two?) and the output pulses from the computer to the fuel injectors – this while someone else cranked the engine. Everything seemed to be working perfectly and so it definitely looked like a wiring loom problem.

Next, I moved the CRO to the engine bay and checked the pulses going directly to the injector connectors. These were all present, so why wasn't it working?

It was at this point that the lamp probe was found and we checked the 12V rail to the injectors again. And whereas the meter had told us there was a full 12V, the lamp told us differently. The 125mA globe (24V 3W) hardly lit, which indicated a high resistance in the wiring loom and/or the relays between this point and the battery.



SECRETLY, I PRAYED TO THE PATRON SAINT OF TELEVISION...

Even though we had the wiring diagram, we still had difficulty following the leads and identifying the various plugs and sockets. To begin with, in order to confirm our diagnosis, we connected a jumper from the fusebox to the injectors and cranked the engine. To our delight, it immediately fired up but the engine stopped as soon as we removed the jumper

It was while we were tracing the 12V rail with the lamp probe that we almost had a disaster. The lamp probe consists of a festoon globe inside a hollow uninsulated metal cylinder with a sharp point on one end. The other end has a lead with a crocodile clip going through an insulator, a spring and another insulator to the other end of the globe. Unfortunately, I pulled too hard on the lead while trying to reach one of the sockets and broke the internal insulator, thereby shorting the lamp completely out.

Immediately, buckets of amps started flowing and the lead started to melt. Fortunately, I was able to break the circuit within a second or two of seeing the smoke – but what damage

had I caused? Well, as it happened, none because when we cranked the engine, it started immediately. The high current had "cleaned out the cobwebs" and improved the bad connection we were trying so hard to find.

This was maddening because this was now a classic Clayton's fix – ie, the repair you have when you are not having a repair! Luckily for us, we had already narrowed it down to a plug and socket near the fusebox marked X07 (white and red wire) and actually wiggling it with a x1 ohmmeter across it saw the needle tremble slightly.

So rather than leave it with a "she'll be right, mate" attitude, we soldered a jumper lead across the plug and socket. The car was then soak tested(!) but it gave us no more grief.

Airing a Subaru

The final story in this computer trilogy of bravely going where no-one else will go concerned a 1990 Subaru, which had an electronically-controlled suspension height system. This consisted of four air-bags in lieu of coil springs that were individually pumped up and down with a compressor and controlled by solenoids. These were in turn controlled by a microprocessor, either automatically or when commanded by the driver.

Of course, the problem was that nothing was happening when the buttons were pushed – the suspension remained in its lowered position. Various other people had had a go at trying to fix the problem and the bone was being pointed at the computer as the likely source.

Once again, we had a wiring diagram for the vehicle, which was a relief, but not for the computer. Initially, I was given the computer box only and told "go fix". I must confess that I wasn't all that optimistic at first but what did we have to lose?

The computer consisted of a large microprocessor chip and a lot of peripherals, plus seven 2SD1392 transistors whose collectors went directly to the connection sockets. Initially, I spent some time checking for all the obvious things (ie, dry solder joints, dry electros and short/open circuits) before turning my attention to the transistors. These all measured good except for one which was badly cooked. You beauty!

I reported back that I had found a fault in the unit but pointed out that some external fault must have caused the damage. There was nothing for it but to check it out in circuit with a lamp probe.

First, we established that there was 12V going into the computer on pins 2 & 3 and that there was also 12V on the collectors of all the transistors. We then identified which transistor did what. Four controlled the airbags at each wheel, one the compressor relay and the other two the charge and discharge valves.

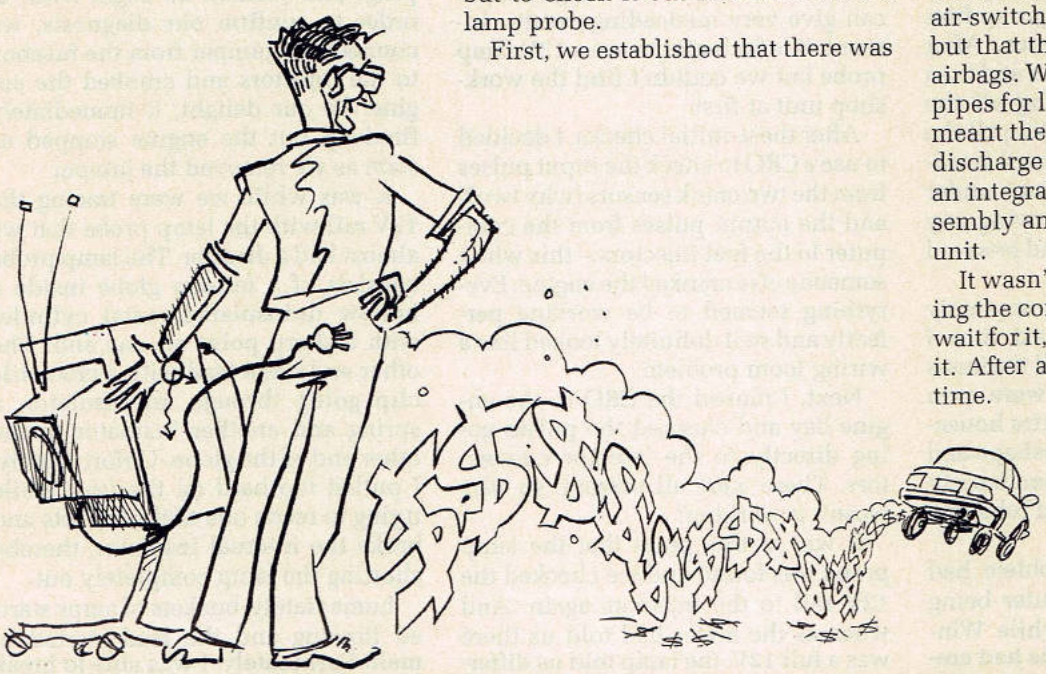
Our next step was to short each of the collector connections on the socket to ground in turn (with the computer unplugged). Each solenoid operated correctly except for the discharge valve which is controlled via pin 1. And guess which transistor controlled pin 1.

Temporarily, we took the discharge valve out of circuit and refitted the computer. This confirmed that it was actually doing its job because we could hear the relays working. So why wasn't the suspension being raised and lowered?

The answer was that the discharge valve was not only short circuit but was also stuck open. Unfortunately, it is mounted on the compressor and this can only be accessed by removing lots of other parts and putting the car up on the hoist (the compressor and valves sit just above and in front of the passenger's front wheel).

At first we thought that we would be scuppered by the hoist because the wheels would drop and the computer would think that the system was fully discharged so we couldn't test it. However, we managed to confirm that the air-switch solenoids were operating but that there was no air to pump the airbags. We checked the reservoir and pipes for leaks but found none, which meant the problem was definitely the discharge valve. Unfortunately, this is an integral part of the compressor assembly and is a totally unserviceable unit.

It wasn't easy removing and replacing the compressor but a new one at – wait for it, almost $2000 – finally fixed it. After all that, give me a telly any time. **SC**



AFTER ALL THAT, GIVE ME A TELLY ANYTIME

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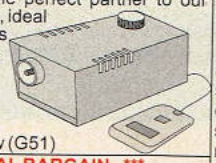

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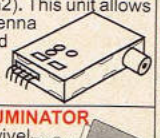

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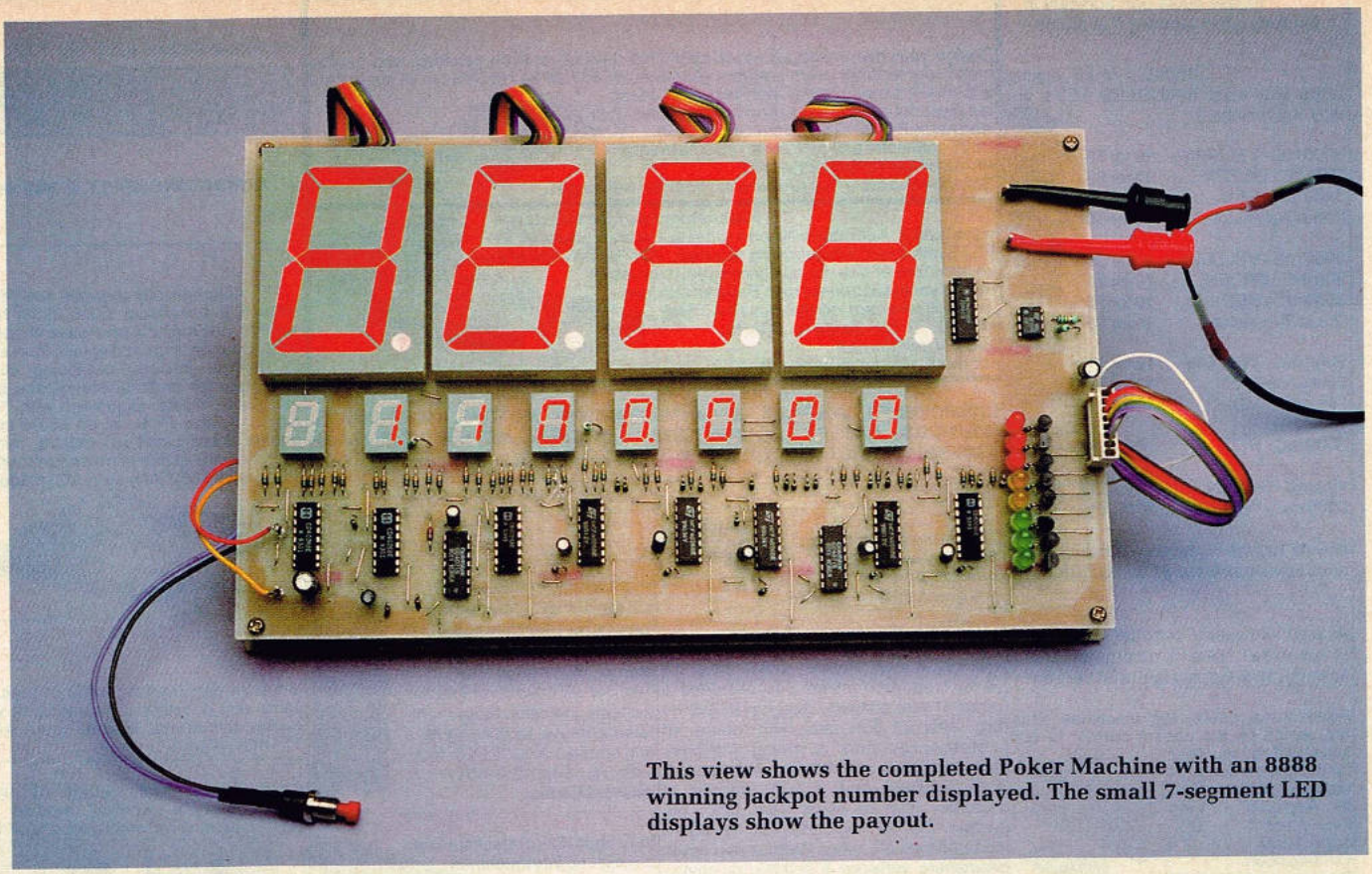


This view shows the completed Poker Machine with an 8888 winning jackpot number displayed. The small 7-segment LED displays show the payout.

Build Your Very Own Poker Machine

Got a gambling habit? Losing thousands? Then rush out and buy the bits for this poker machine. You can play to your heart's content and never lose your shirt. You can even invite all your friends to play and they won't lose their shirts either.

Design by ANDERSSON NGUYEN

With the abundance of poker machines available in clubs, pubs, casinos and various gaming rooms, many of us would have come in contact with one at some time in our lives. This project lets you build your very own 4-digit poker machine, utilising super large 7-segment displays. The circuit also has a score board to let you keep track of your winnings. In addition, the circuit boasts flashing LEDs to indicate the winning combinations (see Table 1).

The points given for each winning combination can also be seen in Table 1. With any four of a kind winning combination, the decimal points of all the super large 7-segment displays light up consecutively, giving a chase effect. Four zeros or four 8s will result in all four digits flashing. Clearly, that's cause for celebration and while you won't have won a fortune you won't lose it later in the session either.

The only other hobby poker machine circuit presently available is featured in the Dick Smith Electronics publication "Fun Way into Electronics" Volume 3. That circuit involves only two digits and is not nearly as complicated as the one presented here. This circuit gives the hobbyist an appreciation of how both digital circuits and the one-armed bandit works.

This Poker Machine consists of two large PC boards sandwiched together. The top board contains all the 7-seg-

ment displays and their driving circuit while the lower board contains all the counters.

Circuit details

Because it is so big, we have had to split the circuit diagram into two sections and even then, it takes up the best part of four pages in the magazine. Fig.1 is the circuit of the main board and includes the counters and magnitude comparators, while Fig.2 is the circuit of the display board.

While the whole circuit appears extremely complicated at first glance the majority of it consists of repeating units.

In explaining the circuit operation we will need to jump from Fig.1 to Fig.2 and back again so here goes. Let's start with Display 1 (DIS1) which is shown on Fig.2 but is driven by IC1, a BCD to 7-segment decoder/driver, on Fig.1. There is no need for current limiting resistors since each segment consists of four LEDs in series and the total supply voltage is only 9V.

The BCD input to IC1 is derived from one section of IC2, a 4518 dual BCD (binary coded decimal) counter. The clock pulse to pin 1 of IC2 (CK1) comes from IC11, a 4046 phase locked loop which is being used simply as a VCO (voltage-controlled oscillator). R2 & C1 set the frequency range.

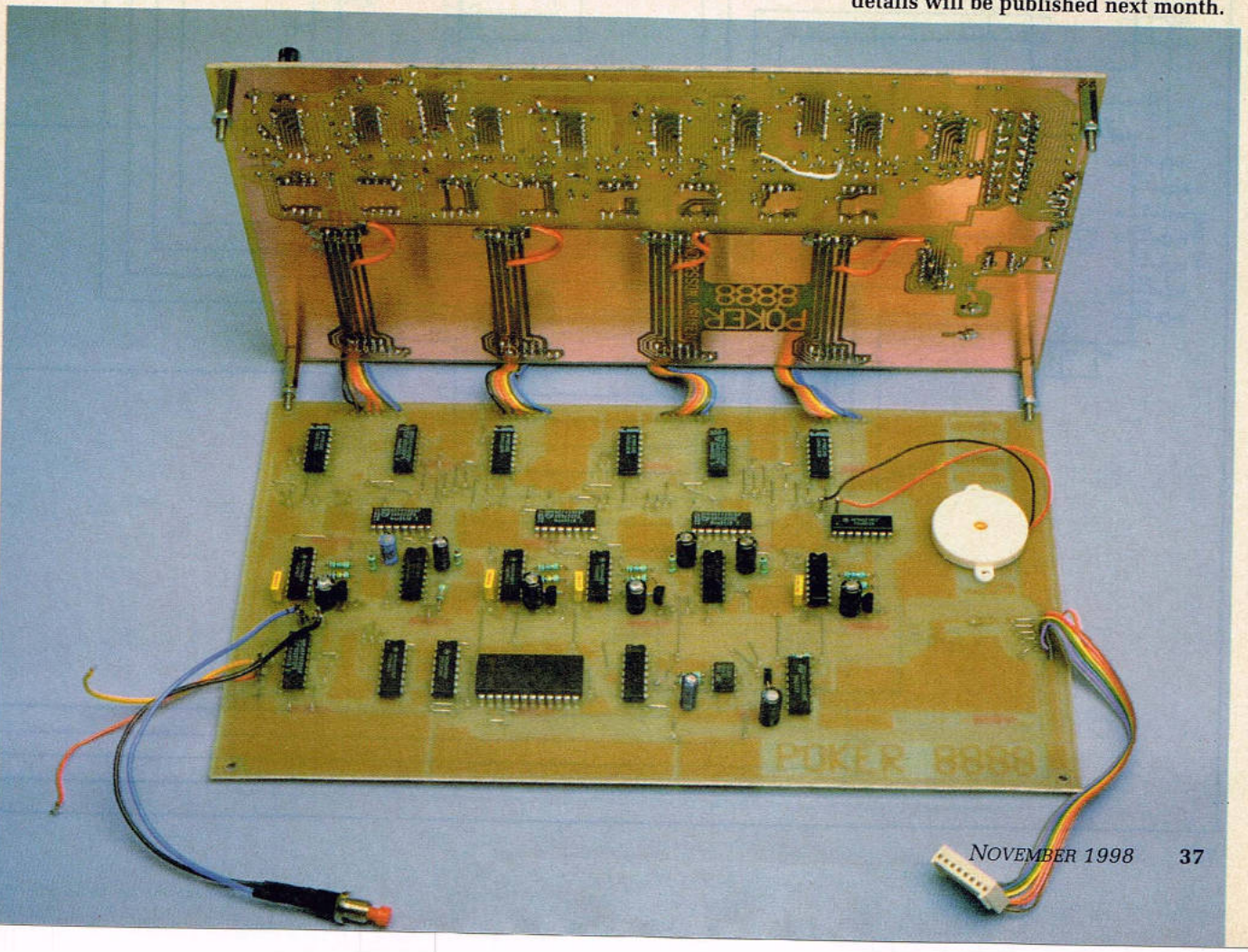
C2 & R3 form an RC circuit such that the voltage input to pin 9 of IC11 varies with time. As the voltage at the resistor-capacitor junction decreases,

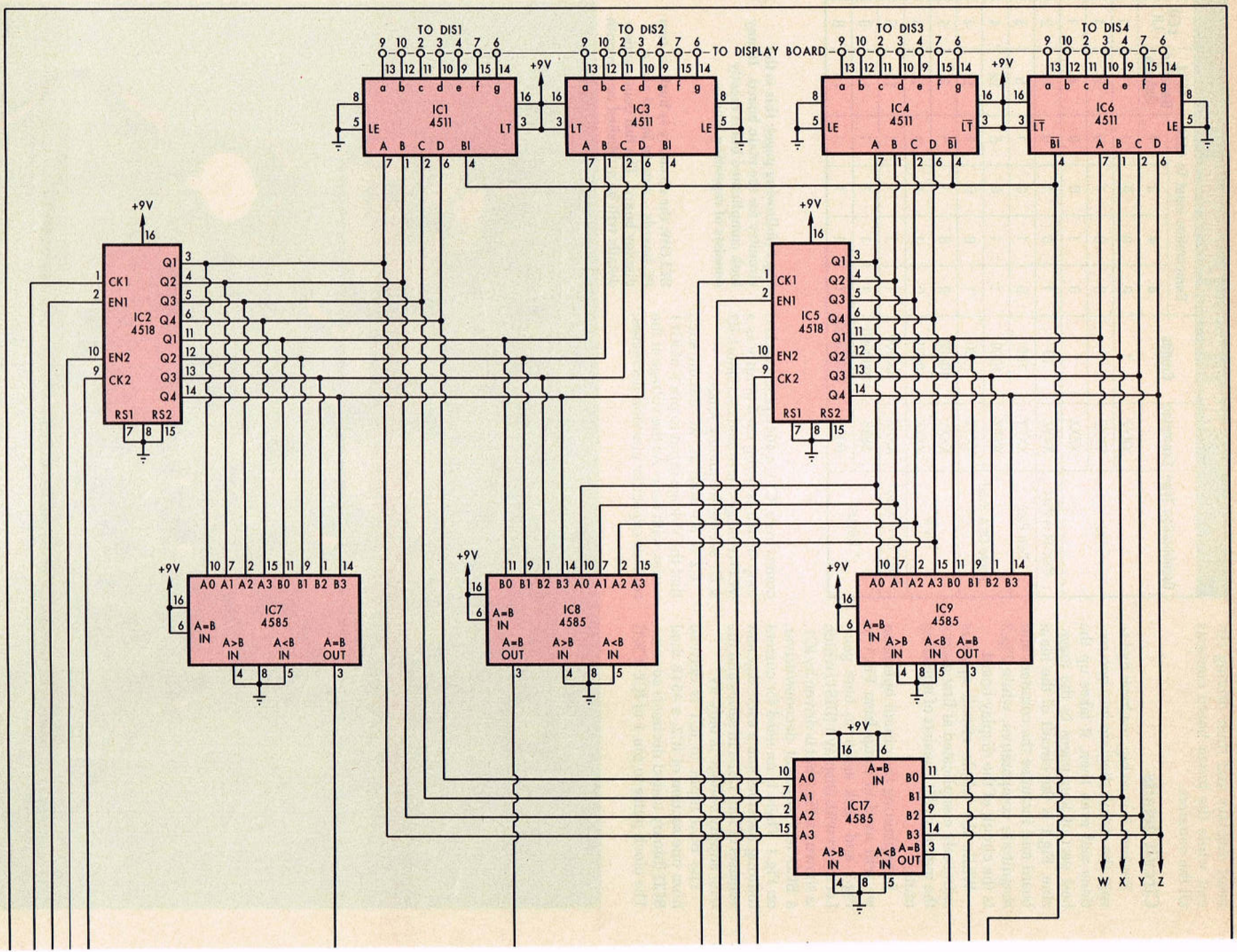
Table 1: Winning Combinations

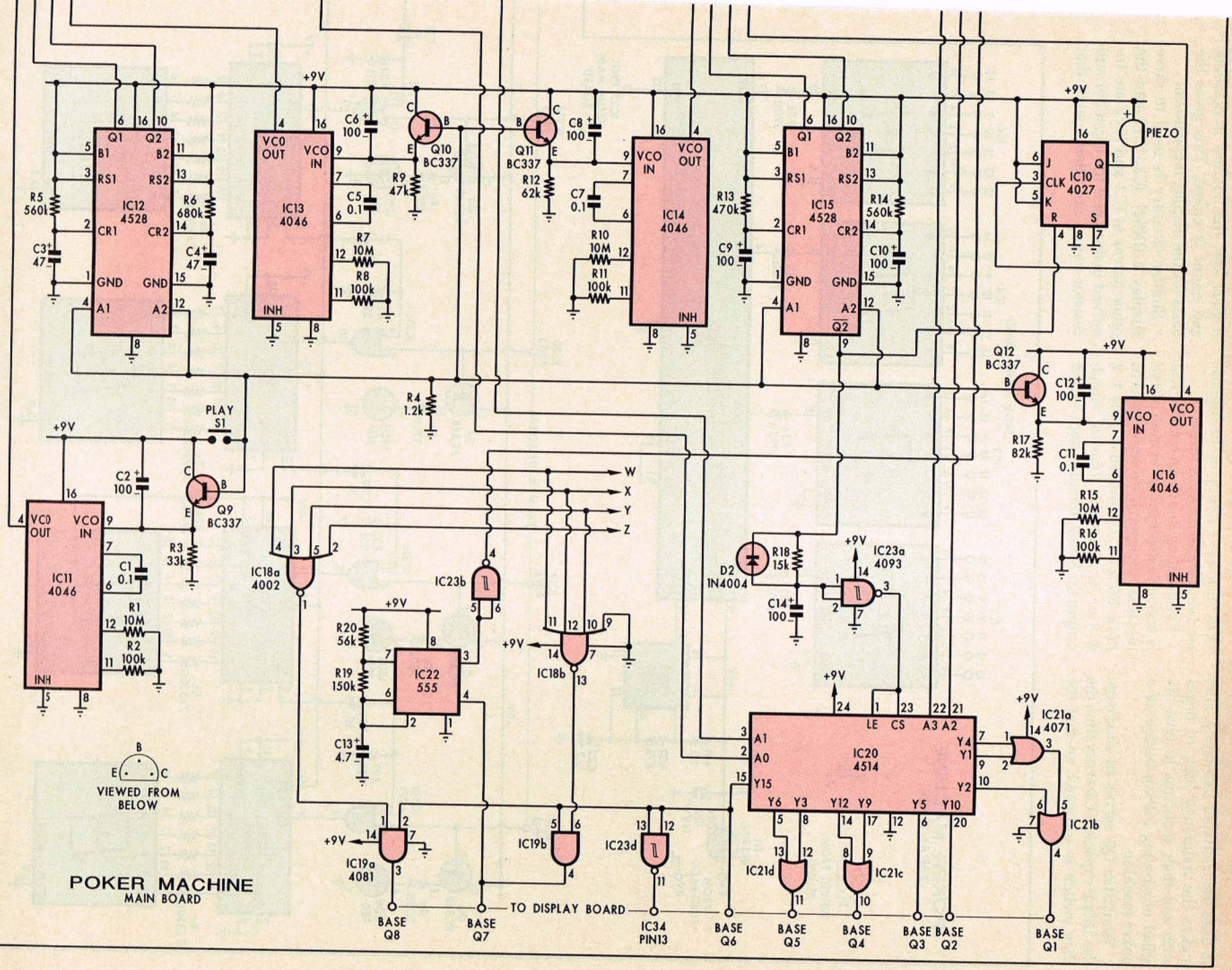
Combination Type	Examples	Credits	Comparators Input To 4514				4514 Decoded Outputs	LED Lit
			8	4	2	1		
Pair	XXYZ	1	0	0	0	1	1	1
	YXXZ	1	0	0	1	0	2	1
	YZXX	1	0	1	0	0	4	1
Pair In A Pair	XYYZ	10	1	0	1	0	10	2
Two Pair	XXYY	100	0	1	0	1	5	3
Three Of A Kind	XYXX	1000	1	1	0	0	12	4
	XXYX	1000	1	0	0	1	9	4
Triple	XXXY	10000	0	0	1	1	3	5
	YXXX	10000	0	1	1	0	6	5
Four Of A Kind*	XXXX	100000	1	1	1	1	15	6
* Bonus	8888	+1000000	1	1	1	1	15	8
	0000	+ 10000000	1	1	1	1	15	8

Fig.1 (following page): this is the circuitry for the main board. It may look complicated but it mostly consists of repeating blocks.

BELOW: the circuitry is built on two PC boards – a main board and a display board. The full construction details will be published next month.




TO DIS1
TO DIS2
TO DIS3
TO DIS4
TO DISPLAY BOARD
+9V
IC1 4511
IC2 4518
IC3 4511
IC4 4511
IC5 4518
IC6 4511
IC7 4585
IC8 4585
IC9 4585
IC17 4585
W X Y Z



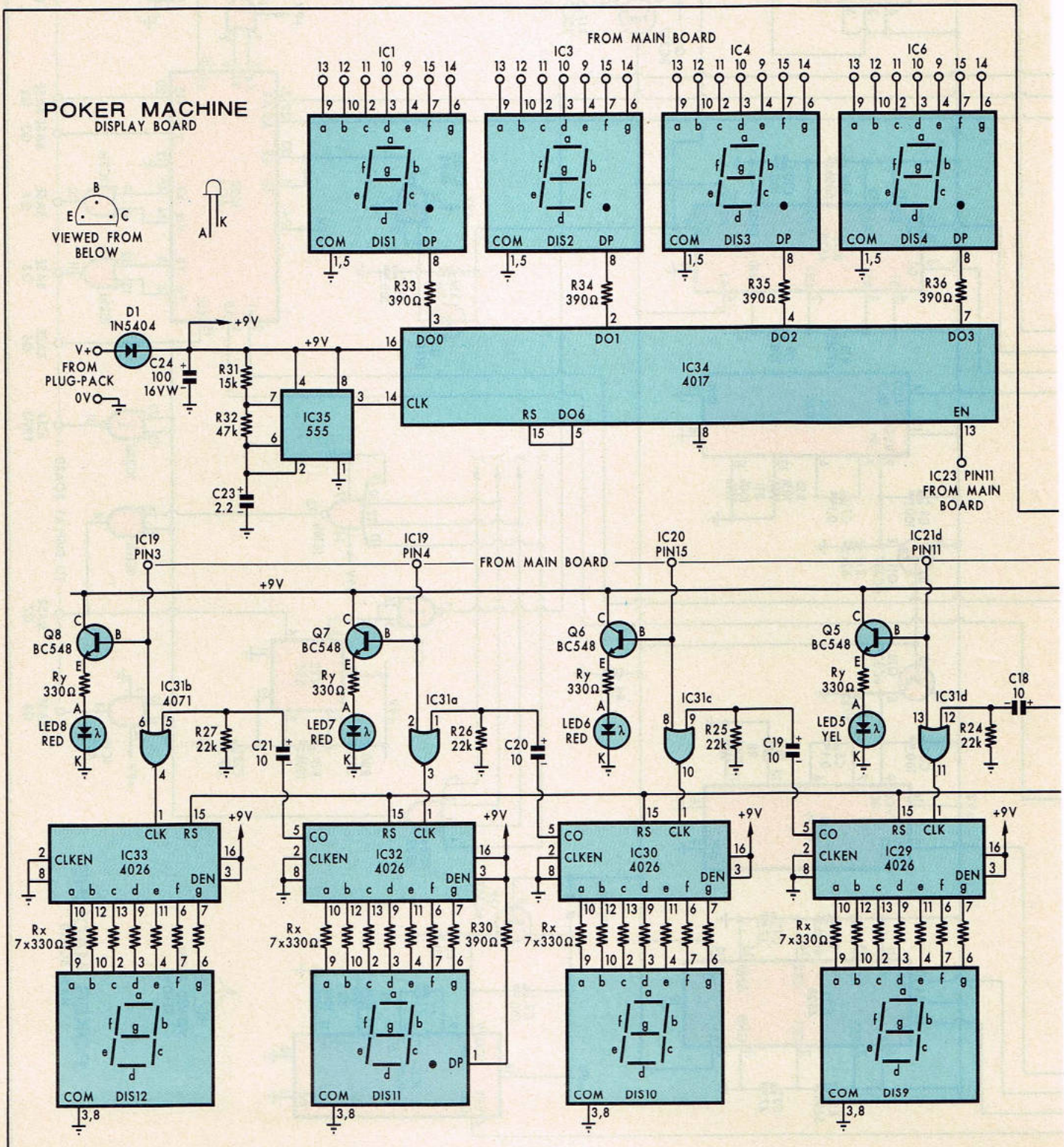
POKER MACHINE
MAIN BOARD

so does the oscillator frequency. This makes the frequency high to begin with and then reducing, to give the effect of slowing rolling barrels of a poker machine.

Transistor Q9 serves to discharge the 100µF capacitor C2 every time the Play switch is activated, so that the VCO output is running at the highest set frequency with each throw.

The duration for which counter IC2 is active is determined by one of the two dual retriggerable monostables in IC12. R5 & C3, connected to pins 1, 2 & 3 of IC12, set the time for which output Q1 (pin 6) remains high. When it goes low, the counter is disabled and count is halted. This gives the basis for the display mechanism.

Similar circuitry is used to drive Display 2 (DIS2). IC3, IC13 and the other halves of IC2 and IC12 are involved instead and the capacitor and resistor values are altered such that



the rate of change of count of DIS2 is slower than DIS1 and stops at a later time.

DIS3 and DIS4 are driven by circuitry almost identical to that used for DIS1 & DIS2, again with alterations to resistor and capacitor values such that DIS3 stops counting before DIS4 but after DIS2. In driving the displays this way, random number combinations are generated.

To obtain a sound effect which suggests the rolling of barrels, the VCO output of IC16 feeds to IC10a, a dual JK flipflop. This drives a piezoelectric transducer to produce a clicking sound for every count advance of the last display. The sound is stopped at the same time as count is halted by holding the reset input of the flipflop high when pin 9 of IC15 goes high.

Magnitude comparators

IC7, IC8, IC9 & IC17 are magnitude comparators and these compare the value of numbers displayed by DIS1 & DIS2, DIS2 & DIS3, DIS3 & DIS4, DIS4 & DIS1 respectively. This is done by comparing the BCD outputs of the respective 4518 counters and one can now appreciate why single counter/7-segment driver ICs (eg, 4026) were not used.

The magnitude comparators are always enabled, with their "A = B" outputs going high whenever the two numbers being compared are equal. This may occur many times before all counting ceases. The four "A = B" outputs of the magnitude comparators are fed to IC20, a 4514 1-of-16 decoder and this device decodes and registers the different winning combinations.

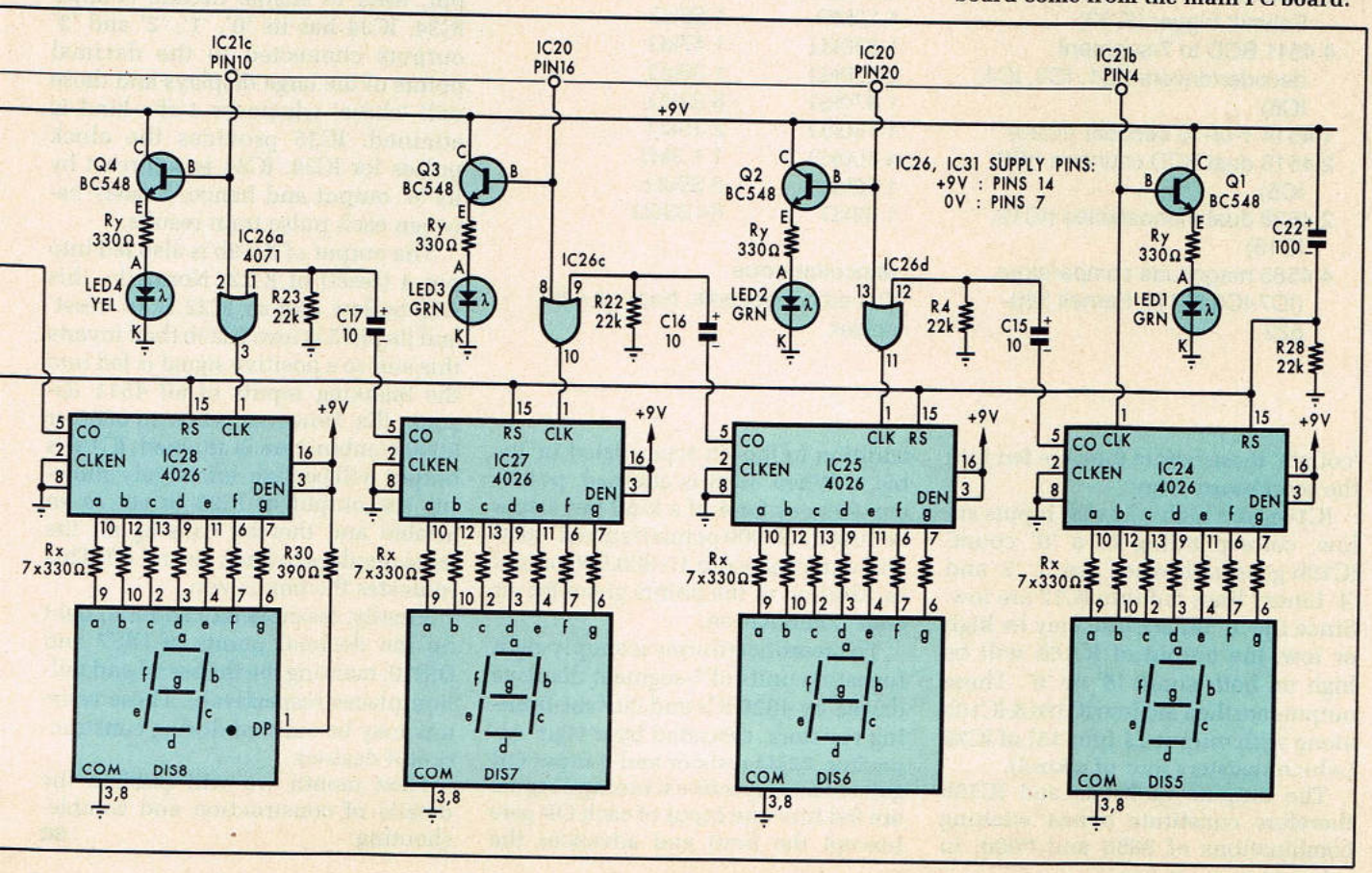
Once all counting has ceased, the outputs of the magnitude comparators are fixed, dependent on the values in their respective displays. For example, if DIS1, 2 & 3 are all equal, then IC7's and IC8's outputs will be high, whereas IC9's and IC17's outputs will be low. This represents a binary equivalent of decimal 3 at the inputs of IC20. Therefore, pin 8 will go high when the device is enabled by bringing the INH & FOLLOW pins (1 & 23) low.

This is achieved by feeding the Q2-bar output of IC15 (which goes high after all counting has ceased) into a delay circuit consisting of Schmitt trigger IC23a, resistor R18, capacitor C14 and diode D2. The output therefore goes low.

The delay mechanism is necessary because, in addition to normal functioning, the 4518 will advance in count when EN (pins 2 or 10) is brought low whilst CLK (pins 1 or 9) is low. Thus, if IC20 is enabled at the same time as IC5 (4518) is disabled, (bringing EN low), there is a risk that an undesirable count occurs. This would result in two output pulses from IC20 as data fed into it from the magnitude comparators changed at that instant. Indeed, even with the delay mechanism in place, undesirable counts can be observed as rapid advances in count just prior to stopping.

Other winning combinations can be seen in Table 1, along with the decoded outputs and points given. As can be seen, there may be several possible outputs for any one winning combination type. The OR gates in IC21

Fig.2 (below): this is the circuitry for the display board. It mostly consists of BCD-to-7-segment decoder ICs (IC24-IC32) and 7-segment LED displays. The input signals to drive the display board come from the main PC board.



Parts List

1 main PC board, 252 x 154mm
1 display PC board, 252 x 154mm
1 9V 1A DC plugpack supply
1 piezoelectric transducer; Jaycar AB-3440 or similar
1 pushbutton momentary action SPST switch
4 25mm spacers; Jaycar HP-0866 or similar
4 4 x 32mm screws & nuts to suit

Semiconductors
2 555 timers (IC22,IC35)
1 4017 divide by 10 counter (IC34)
1 4002 dual 4-input NOR gate (IC18)
8 4026 counter/7-segment drivers (IC24, IC25, IC27-IC30, IC32, IC33)
1 4027 dual JK flipflop (IC10)
4 4046 phase locked loops (IC11,IC13,IC14,IC16)
3 4071 quad 2-input OR gates (IC21,IC26,IC31)
1 4081 quad 2-input AND gates (IC19)
1 4093 quad 2-input NAND Schmitt trigger (IC23)
4 4511 BCD to 7-segment decoder/drivers (IC1, IC3, IC4, IC6)
1 4514 1-of-16 decoder (IC20)
2 4518 dual BCD counters (IC2, IC5)
2 4528 dual monostables (IC12, IC15)
4 4585 magnitude comparators (IC7-IC9,IC17); Farnell 386-522
4 large 7-segment displays; Jaycar ZD-1850 or equivalent (DIS1-DIS4)
8 7-segment displays; Jaycar ZD-1855 or equivalent (DIS5-DIS12)
3 red flashing LEDs (LED6,7,8)
2 orange flashing LEDs (LED4,LED5)
3 green flashing LEDs (LED1,LED2,LED3)
1 1N5404 diode (D1)
1 1N4004 diode (D2)
8 BC548 NPN transistors (Q1-Q8)
4 BC337 NPN transistors (Q9-Q12)

Capacitors
9 100µF 16VW electrolytic (C2, C6, C8-C10, C12, C14, C22, C24)
2 47µF 16VW electrolytic (C3,C4)
7 10µF 16VW electrolytic (C15-C21)
1 4.7µF 16VW electrolytic (C13)
1 2.2µF 16VW electrolytic (C23)
4 0.1µF (C1, C5, C7, C11)

Resistors (0.25W, 1%)

4 10MΩ	1 56kΩ
1 680kΩ	1 47kΩ
2 560kΩ	1 33kΩ
1 470kΩ	8 22kΩ
1 150kΩ	2 15kΩ
4 100kΩ	1 1.2kΩ
1 82kΩ	6 390Ω
1 62kΩ	64 330Ω

Miscellaneous
Tinned copper wire, hook up wire, solder.

'collate' these before they are fed into the scoreboard array.

IC18a goes high when all inputs are low, corresponding to a '0' count. IC18b goes high when the '1','2' and '4' binary lines fed into IC17 are low. Since the '8' binary line may be high or low, the output of IC18b will be high on both count '8' or '0'. These outputs are then fed into IC19a & IC19b along with output 15 (pin 15) of IC20 (which registers four of a kind).

The outputs of IC19a and IC19b therefore constitute bonus winning combinations of 8888 and 0000, in addition to the six types listed in Table 1. When 8888 is attained, points are given as for 4 of a kind but also a bonus (1,000,000 points) is given. 0000 will attract an extra 10,000,000 points in addition to the points given for an 8888 combination.

The score board array is simply eight repeating units of 7-segment displays driven by 4026 ICs and current-limiting resistors, cascaded by a 10µF capacitor, 22kΩ resistor and 2-input OR gates. The respective winning outputs are fed into one input of each OR gate (except the first) and advances the count by one each time a winning combination is registered. The other input to the OR gate is from the divide-by-10 outputs of the previous 4026 IC.

This divide-by-10 output goes high on the 9 to 0 transition, stays high from 0 to 4, goes low on the 4 to 5 transition and stays low from 5 to 9. By staying high for count 0 to 4, the divide-by-10 outputs would inhibit the next counting unit from registering a win (positive clock edge). For this reason, the 10µF capacitor and 22kΩ resistor were included to generate a quick positive pulse to register the carry. This pulse would slowly return to ground as the capacitor charges, thereby allowing the count to proceed. This slow return to ground does not affect operation.

Capacitor C22 and resistor R28 at pin 15 of the 4026s ensure that all scoreboard displays are reset when turned on.

In addition to driving the scoreboard, each winning combination output drives a flashing LED via a transistor to indicate the win (Q1-Q8; LED1-LED8). Furthermore, the 4-of-a-kind winning combination output is fed into IC23d to get an inverted output, used to enable decade counter IC34. IC34 has its '0', '1', '2' and '3' outputs connected to the decimal points of the large displays and these will 'chase' whenever 4-of-a-kind is attained. IC35 provides the clock pulses for IC34. IC34 is self-reset by its '6' output and hence, a delay between each pulse train results.

The output of IC19b is also fed into pin 4 (reset) of IC22. Normally, this will be low and so IC22 is in 'reset' and its pin 3 is low. IC23b then inverts this and so a positive signal is fed into the blanking inputs of all 4511 decoder ICs. However, when an 8888 or 0000 combination is attained, IC19b's output will be high, effectively allowing the output of IC22 to act as an astable and thereby causing all the large displays to flash on and off. This indicates the bonus win.

Finally, resistors R29 and R30 light up the decimal points of DIS7 and DIS10, marking the thousand and million places respectively. These resistors may be omitted during construction if desired.

Next month we will publish the details of construction and trouble-shooting. SC

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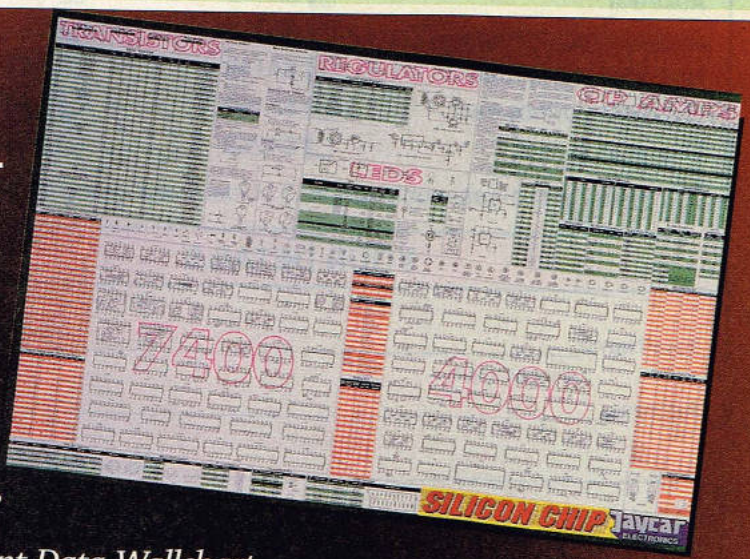

Or perhaps data on a popular transistor, regulator, LED or op-amp. Maybe the pin-outs of 4000 or 7400 series ICs.
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Go straight to your SILICON CHIP/Jaycar Giant Data Wallchart. There's information on selecting the right heatsink, testing transistors, wiring regulators. Plus capacitor marking codes, resistor colour codes, loads of computer information from RAM and EPROMs to ASCII codes and computer port pin-outs . . . Even common audio connector standards! All this in a glossy, coated poster perfect for hanging in your workshop or study!

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Prices valid until November 30th.

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PROFESSIONAL GRADE GARDEN LIGHTING

NEW ITEM

Jaycar is proud to release a new range of die cast high grade low voltage outdoor garden lighting. This range is ideal for the "do it yourself" person. Create amazing lighting effects for your garden with our large range of fittings and choice of different voltage halogen lamps for them. Designed to operate on 12V or 24V. All fittings are black in colour, and are made from die cast high grade material. They are more expensive than those "elcheapo" plastic ones, but these will last for years, long after you have forgotten how much you paid for them.

GARDEN FLOOD LIGHT

Supplied with spike for pushing into the ground and has an adjustable head. Accepts the MR16 halogen globes (not supplied). Size (length including spike) 310mm. Dia. at globe 75mm.

Cat. SL-2770 **$29.95**

GARDEN HIGHLIGHTER

Use a narrow beam halogen globe for excellent high-lighting of palms or shrubs etc. Includes a hood which can be rotated. 320mm approx. length, dia. at globe 65mm. Accepts MR16 halogen globe (not supplied).

Cat. SL-2772 **$29.95**

GARDEN BURIAL TYPE LIGHT

This light is designed to be partly buried so it's not seen, and the light directed up to highlight a tree etc. Has a grill over glass to protect against breakage. Accepts MR16 halogen globe (not supplied) size 100(H) x 96 dia. mm.

Cat. SL-2776 **$29.95**

LIGHT WITH BRACKET & SPIKE

Suitable for a number of jobs. The bracket allows you to mount on a wall or fence, or hang it in a tree. The spike allows you to put it in the ground. Accepts MR16 halogen globes (not supplied). Size 100(H) x 96 Dia. mm. excluding bracket and spike.

Cat. SL-2774 **$29.95**

WALL MOUNT STEP LIGHT

This light will mount on a wall, and is ideal for lighting a path, or steps. All light points down, so there is no glare. Size 100(dia.) x 50(D) mm. Accepts halogen JC pin globes (not supplied). Globes 12V 20W Cat. SL-2722 $2.95 24V 35W Cat. SL-2723 $4.95

Cat. SL-2778 **$19.95**

PAGODA LIGHT

These are basically a pathway light, that will light up the path as well as the surrounding garden. They are all metal construction, and include a spike for mounting. Accepts a BC globe. 12V 15W Cat. SL-2721 $0.95, 24V 20W globe Cat. SL-2719 $0.95. Size 300(H) excluding spike, dia. 140mm.

Cat. SL-2782 **$39.95**

PATH LIGHT

This is a typical type pathlight, which look excellent in a row down a path, they are very low to the ground, and take the MR16 halogen globes. Size 170(H) excluding spike which is 160mm long, dia. 60mm.

Cat. SL-2780 **$29.95**

HALOGEN GLOBES

MR16 ROUND WITH BUILT IN REFLECTOR SUITS THE FOLLOWING LIGHTS: SL-2770, SL-2772, SL-2776, SL-2780

20W 12V 12° Cat. SL-2729 $5.50
20W 12V 38° Cat. SL-2730 $5.50
35W 24V 38° Cat. SL-2736 $5.50

To run off the mains power we suggest you use a Toroidal Transformer in some sort of enclosure.

160W (for 12V) Toroidal Cat. MT-2112	$56.95
300W (for 12V) Toroidal Cat. MT-2130	$74.95
160W (for 24V) Toroidal Cat. MT-2114	$56.95
300W (for 24V) Toroidal Cat. MT-2134	$74.95

PS/2 ADAPTOR

NEW ITEM

D9 Female to 6 Pin Mini Din Female.
Cat. PA-0947
$7.95

BUY 10 LESS 10%

ADJUSTABLE 50MM DOWNLIGHT

NEW ITEM

Install your own professional halogen lighting system anywhere you like. The globe holder is finished in high gloss white and will pivot up to 40° angle which is enough to highlight say, a picture on a wall. Approx. cutout is 90mm. Dimensions - Total width at front is 102mm and the depth is 39mm. This holder suits all of our 51mm 12V halogen lamps. Cat. SL-2739 **$9.95**

10" CLOCK WITH HUMIDITY AND TEMPERATURE

NEW ITEM

Contemporary 20cm black face display with white numbering. Features a precision quartz timing mechanism as well as a temperature display (C/F) & hygrometer. Ideally suited for any home or office. Cat. XC-0112 **$19.95**

WIRELESS INDOOR / OUTDOOR THERMOMETER

NEW ITEM

This fantastic new product will support up to three remote sensors which can be placed anywhere you like and transmit to the main unit which is usually mounted in the house. You can monitor a wine cellar, garage, or nursery etc, all from the one unit.

The main unit features a high/low alarm for every sensor, min/max reading with a temperature range of -5°C to 50°C. The remote sensors are splash proof and have their own digital temperature display and can transmit up to 30m. (Main unit supplied with one sensor).

Cat. QM-7220 WIRELESS IN/OUT THERMOMETER **$119**

Cat. QM-7221 EXTRA REMOTE SENSORS **$49**

HEADSET TELEPHONE

NEW ITEM

Ideally suited to home or office use because the headset allows you to talk on a phone line, without disturbing others, and still have both hands free to work. This is a stand alone headset telephone, not a handsfree adaptor. The headset and mic boom are fully adjustable and the ear piece has comfortable padding. Features last number redial, dual tone electronic ringer, mute button and receiver volume control. (Not suitable for Commander system)

Cat. YT-7060 **$69.95**

HARD DRIVE COOLING KIT

Protect and extend the life of your hard drive with the simple addition of this Hard Drive Cooling Kit. It installs easily in any vacant 5.25" or 3.5" slot in minutes and will dramatically improve the ventilation within the case using dual high efficiency ultra quiet cooling fans. The air filter is easy to access and the kit is supplied with Y adaptor for easy connection to any hard drive.

Cat. XC-5046 **Only $39.95**

NEW ITEM

BUY 5 OF A PRODUCT WORTH $100 OR MORE LESS 10%

BASIC ELECTRONICS

Learn about Electronics. with the basics and ends with an introduction to digital electronics. Stacked full of vital information for those interested in learning about electronics. Great price! 114 pages. Cat. BE-5050

Only $5.95 NEW MEM

COLOUR CCD CAMERA

NEW MEM

1/4" digital, in a small black metal case. Supplied with a BNC socket & DC power socket. Plug into video input socket on VCR or TV, or through RF antenna with a video modulator. Cat. LM-3850 $14.95. Small Size!! Specifications: •Pick up elements:1/4" CCD •Resolution: 330 TV lines •Power Source: 12VDC +/-10% •Size: 36x36x15mm.

Cat. QC-3482 **Only $249.50**

EXTREMELY LARGE DIGITAL CLOCK WITH HUMIDITY, TEMP & CALENDAR

NEW MEM

Ideal for office, factories, homes, wine cellars etc. Includes: •Humidity sensor •Temperature in °C and °F •Calendar with day, date and month •Huge display 146(w) x 95(H) •Overall size 210(W) x 210(H) x 25(D)mm. Cream and silver in colour, operates on 2 AA batteries (not supplied). Cat. XC-0232 **Only $99.95**

CAT 5 SINGLE STRAND CABLE

NEW MEM

Single strand Cat 5 is used for long runs, where as multi-strand (WB-2020) is used for patch leads and short runs. Blue in colour. Cat. WB-2022

95¢ mt. or $75 per 100 mt. roll

BUDGET COMPUTER TOOL KIT

NEW MEM

Includes •IC inserter •Blank hex driver •Reversable bits •T10/T15 driver bit •Phillips 0 & 1/8" slot bit •Phillips 1 & 3/16" slot bit •Nut drivers 3/16" & 1/4" •Spare parts tube •Pearl catch •Tweezers •IC extractor. Cat. TD-2039 $17.95

GME Kingray 4 WAY INDOOR TV/FM AMPLIFIER

NEW MEM

Boost your signal for up to 4 TV's with this indoor mains powered booster. UHF gain is 10dB, VHF gain is variable. Made in Australia. Uses 75Ω TV sockets.

Cat. LT-3286 only **$99.95**

FIG 8 AUTO CABLE

NEW MEM

15 amp 2/26 x 0.3mm. Red/Black figure 8 auto cable.

Cat. WH-3078 **$1.20mt.**

$100/100mt. Roll.

SELF AMALGAMATING TAPE BARGAIN

This tape is polyisobutylene, and "cures" to a single mass once it is taped. Its ideal for sealing, waterproofing & insulating. It is made in England by BICC. Roll size is 25mm wide x 10mtrs long. (We currently sell a roll 20mm wide x 5 mtrs long for $14.95). Limited qty.

Cat. NM-2826 Only $24.95

DURATECH TEMPERATURE CONTROLLED SOLDER STATION

NEW MEM

NOW IN STOCK

Our best ever imported soldering station has arrived. Features quality 60W solder pencil with silicone rubber cord, adjustable temperature from 150 - 450°C, 6 sponges supplied . See Cat. P113 for details.

Cat. TS-1380 **$189**

PLASTIC SIREN COVER

NEW MEM

It had to happen! This will replace our steel version. Will accept 5" siren and has three holes for strobe. 5 year warranty for UV. Complete with tamper switch.

Lower price, steel version was $29.95.

Cat. LA-5112 **Only $19.95**

SVHS LEADS

4 pin "S" Plug to " S" Plug. Gold connectors, 4 pins wired. 2 lengths available.

1.5m Cat. WA-1105 **$9.95**

3.0m Cat. WA-1106 **$11.95**

NEW MEM

MINI SCALE

NEW MEM

This digital scale measures from 0-50g with resolution of 0.1g and from 50-100g with a resolution of 0.2g and has a max. capacity of 100g. It also features a tare/net weight function and auto power off. Amazing small size-only 146L x 80W. Calibrated in Australia. Supplied in a pouch.

Cat. QM-7248 **$199**

0.1g Resolution

TAMPER PROOF TORX SOCKET SET

This set includes 12 different sizes of tamper proof star pieces. Kit includes: •T10, t15, T20, T27, T30 with 1/4" drive sockets.•T40, T45, T47, T50, T55, T60 with 3/8" drive sockets.•3/8" to 1/4" drive adaptor. •Wall mounting brackets. LIMITED QUANTITY AVAILABLE.

Cat. TD-2038 **Was $14.95**

Nov. $10

Save $4.95

BARGAIN CD-R'S

JAYCAR BLUE or BLUE - BULK

Supplied in jewel case Cat. XC-4712 **$2.95 or 10 for $26.50 100 for $250**

Supplied in bulk pack of 10. No cases. Cat. XC-4714 **Pkt 10 $25.95 10 Pkts (100 CD'S) $233.60**

PHILIPS GREEN

Supplied in jewel case Cat. XC-4711 **$3.50 or 10 for $29.50**

RICOH GOLD

Supplied in jewel case Cat. XC-4710 **$4.50 or 10 for $37.50**

"L" TYPE TAMPER PROOF TORX DRIVER SET

This set is supplied in a very handy plastic holder which will clip over a belt, or pants. Supplied with 7 tamper proof torx bits: T10, T15, T20, T25, T27, T30, T40.

Cat. TD-2046 **Was $13.95** **Nov. $8.95** **Save $5**

SCOOP PURCHASE OF THE DECADE AURA INTERACTOR

Plug it into computer games, stereos etc, then put the back pack on and feel all the low frequency sounds. See 98 Cat. page 213 for full details.

Cat. XC-1000 **WAS $249** **ONLY $49.95**

SAVE $199

AURA ADAPTOR CABLE FOR N64 & PLAYSTATION

This pack contains all the leads required to attach the Aura Interactor to your games console and stereo system. Includes RCA piggyback lead, 3.5mm phone to 2 x RCA adaptor lead, RCA joiners and stereo Hi Fi RCA cable. Total value $17.40 Cat. XC-1001 **$11.95**

OVERNIGHT DELIVERY

RESPONSE 15" WOOFERS

NEW ITEM

You wanted them, so here they are! There is a 4 ohm version and an 8 ohm version. They have a pressed paper cone (the best we feel for a 15" driver) & a rubber surround. The voice coil is the usual Re/sponse high quality kapton type, & the magnet weighs a huge 1.8kg. They are ideally suited for that big woofer project & in the correct bass reflex enclosure, will give thunderous performance to very high SPLs.

4 ohm •Nom impedance - 4Ω •Power handling - 250 watts RMS •Frequency range - 23-2000 hertz •Sensitivity - 95dB 1 watt, 1 metre •Cone area (square metres) - 0.085 •Magnet weight - 60oz (1.89kg) •Voice coil inductance (Le) - 0.87mH (at 1k)

4Ω model Cat. CS-2248 $299.50

8 ohm •Nom impedance - 8Ω •Power handling - 250 watts RMS •Frequency range - 18-2000 hertz •Sensitivity - 94dB 1 watt, 1 metre •Cone area (square metres) - 0.085 •Magnet weight - 60oz (1.89kg) •Voice coil inductance (Le) - 1.42mH (at 1k)

8Ω model Cat. CW-2148 $299.50

Speaker Size: A - 385mm, B - 370mm, C - 350mm

MOTOROLA CELLULAR BAG PHONE BATTERY

NEW ITEM

Genuine Motorola 12V sealed lead acid battery, No. SNN4139A. Size 181(L)x60(H)x22(W)mm. Limited quantity available

Be quick. Grab a spare. Cat SB-2595 **$69.95**

We have a very small quantity of Motorola mains chargers for this battery. Type SPN4193C.

MIL-SPEC SWITCHMODE POWER SUPPLY

NEW ITEM

U.S. made, 5, 12, 24V remote voltage sensing. Another spectacular surplus stock purchase. 100 watt switchmode power supply. Note These are not surplus power supplies out of PC's - They are made to MIL-STD-810E (vibration) and conform to an unbelievable number of international standards. The model (Lambda SVS100-5-001) is rated at 100 watt output. This means that you can pull 20 amps at 5V, 8.3 amps at 12V or 4.3 amps at 24VDC up to a total of 100 watts. The unit is short circuit proof and will operate from AC mains voltages of 85-264V 47-63Hz! Features: •No fan cooling assistance required •Fantastic line and load regulation •Case dimensions: 190(L) x 120(W) x 50(D)mm. Jaycar only has a modest quantity of these so be quick! No Rain Checks! First in to see will buy. Cat. MP-3046 **Only $89.00**

240V Wind Up Extension Reel

No more tangled extension leads. Extends to 12.5m Cat. PS-4135

was $39.95 save $10 NOW $29.95

SUPERSONIC MOTH REPELLER

Cat. YS-5530

Save $9.95 Was $29.95

Now $20

LASER POINTERS MAX LEGAL POWER

Cat. ST-3100

PEN TYPE $29.95 SAVE $10

KEYRING TYPE

Cat. ST-3102

$29.95 SAVE $10

DUAL SONIC PEST REPELLERS

Was $34.95 Save $9.95. Cat. YS-5500

NOW $25 Includes mains adaptor

8" WALL CLOCK

NEW ITEM

A very easy to read display with large digits and quartz timing mechanism. White face with black numbering. Ideally suited for large working environments (Dia. 20cm).

Cat. XC-0110 **$12.95**

8" 24 HOUR WALL CLOCK

Military, airlines, travel agents, ham radio operators and others all still use 24 hour time. Designed with white face with black numbering and quartz timing mechanism. Dia 20cm

NEW ITEM

Cat. XC-0111 **$19.95**

LIGHT DIMMER SELLOUT!!!

Set the mood in your room by dimming the lights. See cat P104 for full details. Limited qty avail.

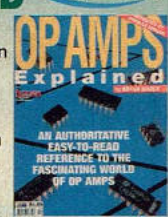
SMALL PLATE Cat. PS-4082

LARGE PLATE Cat. PS-4084

Were $16.95ea Save $4.95 SELLOUT PRICE $12ea

OP AMPS EXPLAINED

NEW ITEM



This book is a collection of eighteen episodes of the series 'Op Amps Explained' as published in EA from March 94 to Nov 95. It is the authoritive easy-to-read reference recommended to all interested in linear electronics, op amps and their applications, whether at hobby level, university or college student. Softcover 20x28cm. 120 pages

Cat. BE-5060 **$5.95**

LARGE PLASTIC LOCKING CORNER PIECE

PKT 8 Cat. HM-3830

Was $14.95 Save $4.95 Now $10

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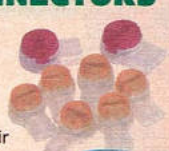
SCOTCHLOCK WIRE CONNECTORS



The easy way to connect 2 or 3 wires together. Simply insert into the connector, & squeeze with a pair of pliers. They are filled with sealant to provide moisture resistance. Accepts cable up to 2.08mm OD. Pack of 8. (6 x 2 wire) and (2 x 3 wire) connects.

NEW ITEM

Cat. HP-1214 **$3.95**

DELUXE RACK CABINETS

These beautifully constructed rack cabinets are now supplied complete with the black front panel to give your equipment a professional appearance.

Cat. HB-5410

44mm Black Rack Case $69.95

Cat. HB-5412

88mm Black Rack Case $87.95

HEX SCREWDRIVER

Use for the Driver Bits Sets on right.

Cat. TD-2032

$4.50

The "Full House" Power Driver Bit Set

Consists of 32 odd driver bits: •Tri-wing, Torx (tamperproof), Pin drive In - Hex (allen), Torque .

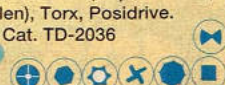
Cat. TD-2035 **WERE $29.95 $14.95**

"Son of Full House" Power Driver Bit Set

$14.95

Consists of 32 more odd driver bits: •Clutch drive, square drive, Hex (allen), Torx, Posidrive.

Cat. TD-2036



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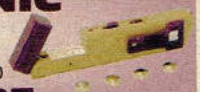
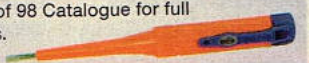


Many uses. Cat. QP-2270

Only $17.95

"SMART" TEST SCREWDRIVER

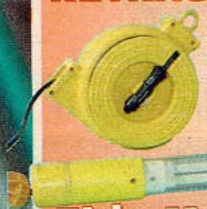
See page 30 of 98 Catalogue for full specifications.



Cat. TD-2055

Only $9.95

12V / 9W FLUORESCENT HAND LIGHT WITH RETRACTABLE CORD



Excellent quality at a fantastic price.
5.5 metre length cord.
Cat. ST-3032

Normally $49.95
Save $10
This Month $39.95

LEARNING REMOTES

MINI REMOTES PRE-PROGRAMMED

Cat. AR-1700

Now $34.95

4 IN 1 UNIVERSAL REMOTE CONTROL

Cat. AR-1705

$79.95

ULTIMATE REMOTE WITH BACK LIGHT

Operates up to 8 pieces of equipment

Cat. AR-1725

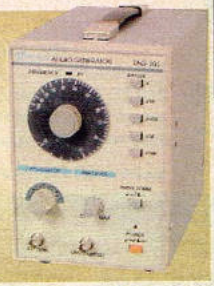
Was $179.50
Now $169.50

ALUMINIUM CASE WITH FOAM INSERT

Ideal video or camera case

Cat. HB-6356 **$69.50**

AUDIO SIGNAL GENERATOR



See page 31 in our 98 catalogue for full specs. Cat. QT-2300

Only $269.00

ATTENTION ADELAIDE CUSTOMERS

WE HAVE MOVED TO 191 WRIGHT ST. OPPOSITE OUR OLD STORE
COME & VISIT OUR HUGE NEW SHOWROOM.
Ph: 08 8231 7355
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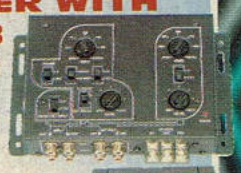
CAR SOUND $AVINGS

BASS DRIVER WITH REMOTE CONTROL QUALITY SUB WOOFER CONTROL SYSTEM!!!

Cat. AA-0426

Were $159 Save $30
This Month $129

2 WAY ELECTRONIC CROSSOVER WITH REMOTE SUB LEVEL CONTROL



Cat. AA-0424

Were $119
Now $89
Save $30

15 BAND EQ WITH 2 WAY CROSSOVER AND REMOTE SUB VOLUME CONTROL

"For those who want the best in car audio performance"

Cat. AA-0422

Were $339
Save $40
This Month $299

1/2 DIN DASH MOUNT PREAMP WITH CROSSOVER

Cat. AA-0425

Were $169 Save $25
This Month $144

UNDIRECTIONAL WIRE / WIRELESS MICROPHONE

Cat. AM-4094

Was $55
Save $15.50
Now $39.50

ULTRASONIC CLEANER

Settings for 4, 8, 12 and 16 minutes.
Cat. YH-5400

$169.00

6500 8 SECTOR COMPREHENSIVE Jaytech ALARM SYSTEM

Ideal for larger houses or simply those that demand the ultimate protection at an amazing price. This is a pro system that would cost a fortune if it was installed by a specialist alarm installer. Do it yourself and save a bundle!
See page 77 of '98 Catalogue for full details.
Cat. LA-5446

SAVE $$$

Normally Pay $500.45

Only $429.00

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Vol 1 A to Z

Softcover 1547 pages.
Size 147 x 107 x 60mm.
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$29.95

BUY BOTH & SAVE $5

MULTI FUNCTION ELECTRONIC TESTER

Cat. QP-2260

Was $17.95 Save $5
Now $12.95

HALL EFFECT SWITCHED DEVICE

Manufactured by Siemens in Germany.

Cat. ZD-1900

Was $29.95 Save $5
Now $24.95

SONY E180 VHS VIDEO TAPE

Top quality, made in the U.S.A.
Cat. AR-1455

$5.95 OR 10 FOR $50

BUY 5 OF A PRODUCT WORTH $100 OR MORE LESS 10%

Metal Magnetic Dish

This clever product will retain all manner of hardware. The enamel coated metal bowl is magnetised, even if the bowl is tipped over the parts will stay put. Rubber non slip base. Cereal dish size.

Cat.TH-1970

$10.95

MAIL ORDER - FREECALL FOR PHONE ORDERS 1800 022 888 / NEW ZEALAND 0800 4529 227

AMAZING DISTRESS STOCK PURCHASE

We have made a stock purchase from a manufacturer who had some orders cancelled by their customer. This purchase includes computer microphones, headphones, computer headsets & some excellent computer speakers, and they even include mains power supplies! Save a fortune over what these would normally cost. There is only a limited quantity of these products, so don't wait.

GREAT OPPORTUNITY TO BUY AN EARLY CHRISTMAS PRESENT!!!

AMPLIFIED WALKMAN SPEAKERS

Get up to 24 watts (12 watts PMPO per speaker) of stereo sound from your personal computer CD or cassette player with these terrific personal speakers. Plugs directly into the headphone socket and features gold connectors, individual volume, treble boost and dynamic base boost controls. Requires 4 x 'C' size batteries or 6 VDC plug pack.
Size 155(H) x 95(W) x 90(D) mm (ea).
Cat. CS-2425

Normal Price would be $49.95 Pair
Only $37.95 Pair

MINI MULTIMEDIA COMPUTER SPEAKERS

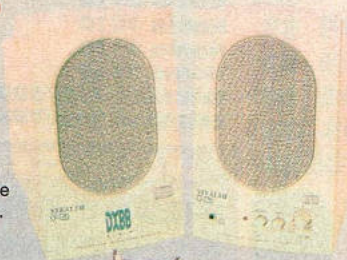
A pair of great sounding mini multi media speakers at a fantastic price. Features: Gold audio plug, 16 watt PMPO per speaker with bass boost switch and volume control. These speakers are fully shielded and will operate from either 4 x 'C' size batteries or the plug pack which is included. Size 135(H)x84(W)x92(D) mm.
Cat. XC-5163

Normal Price would be $55 Pr
Only $39.95 Pair

Plug Pack Supplied

NEW HEM

LARGE MULTIMEDIA COMPUTER SPEAKERS



Fully shielded and has the same features as XC-5163 but with an amazing output of 36 watts PMPO per speaker and additional 3.5mm stereo headphone jack. Speakers supplied with 1.2 amp, 9 volt plugpack. Size 170(H) x 104(W) x 118(D) mm.
Cat. XC-5164

Normal Price would be $79.95 Pr.
Only $59.95 Pr.

Plug Pack Supplied

NEW HEM

JUMBO MULTIMEDIA COMPUTER SPEAKERS

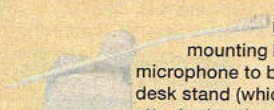
The biggest of them all. These speakers will produce 120 watts PMPO per speaker of quality sound from your PC. Once again they are fully shielded with individual base and volume controls, 3.5mm stereo headphones and microphone jacks. Supplied with a massive 2.5A, 12VDC power supply worth around $40 on its own!
Size 213(H) x 123(W) x 128(D) mm.
Cat. XC-5165

Normal Price would be $129 Pr
Only $99.95 Pair

Mains Power Pack Supplied

NEW HEM

MULTIMEDIA MICROPHONE



Unique multi mounting bracket allows microphone to be mounted on the desk stand (which is supplied) or attached to the side of the monitor (self adhesive pad supplied.) If the mic. is used on a multimedia sound card, power is supplied from sound card for electret insert. If not used with sound card, microphone requires 1.5 volts. Data supplied with mic. For specs see '98 Cat page 197.

Cat. AM-4082
Was $14.95
Now $10
Save $4.95

COMPUTER MICROPHONE

This Omni - directional condenser microphone is designed for computer multimedia systems. Its supplied with a small bracket which will mount on your monitor and it incorporates a lapel clip for wearing. For specs see '98 Cat. page 197.

Cat. AM-4081
Was $9.95
Now $6.95
Save $3.00

COMPUTER MICROPHONE HEADSET

The headset has adjustable length arms to suit all users and a mic boom that rotates up out of the way when not required and can also be bent up to suit the user. For specifications see '98 Cat. page 197.

Cat. AA-2028
Was $19.95
Now $14.95
Save $5.00

HIGH QUALITY TV/HI FI HEADPHONES

Features 5 metre extra long cord with individual volume control, mono/stereo selector switch and a gold 3.5mm plug with gold 6.5mm adaptor. The headband is lightweight, fully adjustable and has cushioned ear pads.
Cat. AA-2002

Normal Price would be $14.95
Only $9.95

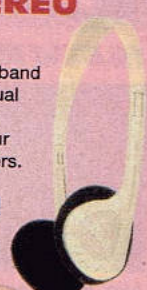
Volume Control

LIGHTWEIGHT HEAVY BASS STEREO HEADPHONES

Designed for extra base performance. Fully adjustable headband and speakers for greater comfort. Supplied with 3.5mm plug and 6.5mm adaptor.
Cat. AA-2007

Normal Price would be $19.95
Only $14.95

COMPUTER STEREO HEADPHONES



Fully adjustable lightweight headband with cushioned ear pads. Individual volume control with mono/stereo selector switch. Play a CD on your computer without disturbing others.
Cat. AA-2034

Normal Price would be $14.95
Only $9.95

Volume Control

TURN YOUR SURPLUS STOCK INTO CASH!

Jaycar buys surplus/distress stock of most electronic products from components to built products. If you have marketable quantities of stock you need to clear contact Bruce Routley

Phone: 02 9743 5222 Fax: 02 9743 2066

JAYCAR WHOLESALE

All Jaycar products are available at very competitive wholesale prices. If you are tired of your current unreliable supplier, why not give Jaycar a try. You'll be pleasantly surprised.

SCARY MAGNET IN 3 SIZES

NEW ITEM

Incredibly powerful magnets! So powerful, they are scary! Made from neodymium iron boron, these are extra strong. All supplied in a protective iron shielded case.

SMALL 10mm Dia. x 3mm - Packet of 4
Cat. LM-1622 **$9.95**

MEDIUM 25mm Dia. x 5mm.
Cat. LM-1618 **$14.95ea.**

LARGE 35mm Dia. x 5mm.
Cat. LM-1620 **$22.95ea.**

BARGAIN 50VA TOROIDAL TRANSFORMER

NEW ITEM

Jaycar has secured a limited quantity of European made P.C. mounting encapsulated toroidal transformers. These can be PCB mounted via the 3mm long pins or turned over and bolted down. The PCB pins can then be used as solder terminals. Each unit has four separate 12V windings allowing the following: 12V @ 4A, 24V @ 2A, 36V @ 1A + 12V @ 1A, 48V @ 1A. Cat. MT-2160

A bargain at only $17.95

BATTERY MADNESS

AA NICAD 800MA
Cat. SB-2450 **Were $3.50**
November $2.75ea.

AA NICAD 800MA SOLDER TAGS
Cat. SB-2451 **Were $3.75**
November $3ea

WHAT A FLOP! Why Take The Risk??

RADIATION PHONE CASES

No one seems terribly interested in the fact that mobile phones may fry your brains! Now you don't have any excuses!

Only $5 each.

Microtac	Cat. HC-6920
Motorola 8200,8400	Cat. HC-6922
Motorola Flare	Cat. HC-6924
Motorola 8500,8700	Cat. HC-6926
Nokia 2110	Cat. HC-6930
Nokia 1610	Cat. HC-6932
Nokia 8110	Cat. HC-6934
Nokia 3110	Cat. HC-6936
Ericsson 318/388	Cat. HC-6938
Ericsson 738/788	Cat. HC-6940

MEMORY IC DATA & COMPARISON REFERENCE

Cat. BM-4575
Was $49.94
Save $24.95
Now $25

NEW LOWER PRICES ON SPEAKER GRILLS

Black metal grills, supplied complete with mounting screws, lugs etc.

SIZE	CAT NO	WAS	NOW	SAVE
6-6.5"	AX-3518	$8.95	$5.95	$3
8"	AX-3520	$8.95	$5.95	$3
10"	AX-3522	$11.95	$7.95	$4
12"	AX-3524	$13.95	$8.95	$5
15"	AX-3526	$16.95	$10.95	$6

DRASTIC REDUCTION

32K DIGITAL ORGANISER

Telephone directory, schedule reminder, memo, currency conversion, clock with world time and 12/24 hour and alarm, calculator.

Cat. QM-7340 **Save $20**
Was $49.95
Now $29.95

64K UNIT Cat. QM-7345
Save $15 Was $65
Now $49.00

3 IN 1 DETECTOR

A quality tool that will find wooden studs, metal, nails, screws and voltage. When anything is detected, a LED will light up next to the corresponding symbol - and a buzzer will sound. Includes a 2 way switch, one position for studs, the other for metal and voltage. Also has a low battery warning. Uses a 9V battery not supplied. Size 175 x 38 x 23mm.

Cat. QP-2280 **Only $29.95**

REWRITABLE CD

74min. 650mb

Cat. XC-4720
$39.95

ZIP DISKS

Now available at Jaycar. 100mb IBM formatted.
Cat. XC-4760
$29.95ea.
10+ less 10%

INTERNET PHONE!!!

See July ads!

Cat. XC-5100
$24.95

JAYCAR KITS

FRONT END KIT FOR PC SOUNDCARDS

REFER: EA AUGUST 1998 Don't just use your soundcard for playing games - turn it into an audio analyser instead! Audio analyser and monitoring software is readily available over the internet & bulletin boards to turn your PC into a spectrum analyser, CRO or loudspeaker analyser. Kit includes case, PCB plus all electronic components.

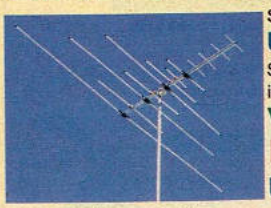
Cat. KA-1811 **$28.95**

PHANTOM POWER SUPPLY KIT FOR MICS & DI BOXES

REFER: EA MAY 1998 There are a number of situations where this phantom supply will help produce a superior and more reliable quality of sound in both recordings and PA systems. Kit is supplied short form with PCB, transformer plus all specified electronic components. Refer to our 98 Catalogue for our range of suitable XLR connectors and enclosures to suit your personal requirements.

Cat. KA-1808 **$19.95**

SAVE ON TV ANTENNAS



SEE 98 CAT. PAGE 190 FOR DETAILS.

UHF/VHF BARGAIN ANTENNA

Suitable for medium to good reception areas. Balun required if coax cable used (LT-3026 $4.95). Cat. LT-3140

Was $55 Save $13
November $42

UHF/VHF FRINGE BARGAIN

Ideal for fringe reception areas. Note:-VHF elements are 1.3mtr long - so beware if you live in an area with large birds!!! Cat. LT-3142

Was $89.95
Nov $72.95
Save $17

BOOK SPECIALS!!!

BM-2497 Computer Viruses	Was $19.95
BB-7439 Microsoft Publish for Win95	Was $18.95
BB-7437 Intro. to Web for PC/Mac Users	Was $20.95
BB-7422 Expand, Modernise and Repair PCs	Was $18.75
BB-7438 Using Nescape on the Internet	Was $20.95

All of these Just $10 each.

OVERNIGHT DELIVERY

BOX BARGAIN

We are overstocked due to a cancelled order. It is the largest of our high quality polystyrene range, as featured in our '98 Catalogue, page 105. Size is 190(L) x 100 (W) x 40(H) mm. Cat. HB-6036

Current Price $14.50 Save a Fortune

Buy 1 $10ea
Buy 10 $8.50ea
Buy 100 $7.50ea

9V AC 1 AMP PLUGPACK BARGAIN

Grab some of these while you can. Surplus stock purchase of 240V AC adaptor plugpacks to 9V AC at 1 AMP. Terminated to a 2.5mm DC plug. Cat. MP-3024

Normally $14.95ea.
November $10ea
Buy 10 $8ea. Buy 50 $7ea.

For bigger quantity contact our Wholesale Department.

GLASS ANALOGUE CELLULAR CAR ANTENNA

OLD

Complete antenna with base, lead, instructions etc. with mini UHF plug. Limited quantity. Brand new stock. Cat. DC-4045

Only $25.00

GENUINE MOTOROLA "BRICK" CELLULAR PHONE CHARGING BASE/AC ADAPTOR

(14.5VDC 710mA) Limited qty. Cat. MP-3150 Brand new stock.

OLD

Only $20ea

SPEAKER STANDS

SMALL Cat. CW-2842 **$69.95**

LARGE Cat. CW-2845 **$89.95**

SOLD PER PAIR

1AH AA NICAD BARGAINS

STOCK UP AT THESE PRICES!!

Standard Type Normally $4.75ea **November $3.75ea or 10 for $30** Cat. SB-2440

Solder Tags Normally $4.95ea **November $3.95ea or 10 for $32** Cat. SB-2441

CAR CELLULAR WINDOW ANTENNA

STICKY BASE

OLD

LIMITED QUANTITY. Brand new stock. Cat. DC-4046

Only $3ea

GOLD INLINE FUSE HOLDERS

AMP-KING

Accepts 5AG fuses

8GA Cat. SZ-2066 **Was $9.95 Now $7.95**

4GA Cat. SZ-2068 **Was $9.95 Now $7.95**

PHONE CALLER ID

Displays the number of incoming calls. Cat. YT-6010

NEW

Only $59.95

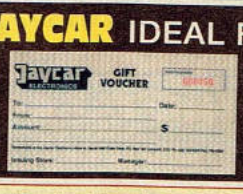
MOTOROLA " BRICK" GENUINE BATTERIES

OLD

7.5V Nicad battery. Don't pay $50! These are now very scarce! Brand new stock. Cat. SB-2565

Only $20ea

GIVE A JAYCAR IDEAL FOR XMAS GIFT CERTIFICATE



SOUND / LUGGAGE /SAFETY BELT

Ideal for Xmas. Cat. AR-1790

Was $9.95 Save $3 Now $6.95

NOKIA N1000 HANDS FREE CAR KIT

Includes clip on microphone, phone base adaptor, extension speaker (worth $16.95 on its own) and cabling. Only 180 available. Ideal for re-installation of virtually any phone. Brand new stock.

OLD

Cat. YT-7080 **Only $25**

THE LATEST KITS

Cat. KA-1812	EA Oct. 98	A/V Signal Power Switch	$55.00
Cat. KA-1811	EA Aug. 98	Sound Card Front End	$28.95
Cat. KA-1810	EA June 98	Masthead Amp	$34.95
Cat. KA-1809	EA May 98	Super Ear	$23.95
Cat. KA-1808	EA May 98	Phantom Power Supply	$19.95
Cat. KC-5252	SC Oct. 98	12V 2A Float Charger	$57.50
Cat. KC-5251	SC Oct. 98	Guitar Sustain Compressor	$75.00
Cat. KC-5250	SC Sept. 98	Gear Shift Light	$37.95
Cat. KC-5249	SC Sept. 98	Waa Pedal for Guitars	$34.95
Cat. KC-5248	SC June 98	Uni Stepper Motor Controller	$64.95
Cat. KC-5247	SC June 98	High Energy Ignition	$55.00
Cat. KC-5246	SC 98	Receiver Decoder for KC-5245	$37.95
Cat. KC-5245	SC 98	Command Station - Railway	$39.95
Cat. KC-5243	SC May 98	3 Led Logic Probe	$14.95
Cat. KC-5242	SC Mar. 98	Sustain Pedal for Guitars	$25.95
Cat. KC-5241	SC Jan. 98	12V 2 Lamp Flasher	$28.95
Cat. KJ-8700	SC June 98	Metal Detector	$17.95

CAT 5 UTP SPLITTER

RJ45 plug to 2 x RJ45 sockets. Accommodates 2 services over the one cable. Typically a single 4 wire telephone & a standard Ethenet computer, or 2 PC's can be used over one cable. Standard wiring. Length 150mm. Cat. YT-6090

Only $16.95

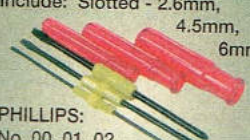
TEMPERATURE ADJUSTABLE SOLDERING IRON BARGAIN

Grab a spare at this silly price! Adjust from 250°-450°. 30 watt rating. Cat. TS-1460

Normally $49.95 Save $12 Now $37.95

3 PC REVERSABLE SCREWDRIVER SET

Include: Slotted - 2.6mm, 4.5mm, 6mm



PHILLIPS: No. 00, 01, 02. See 98 Cat. page 117 for details. Cat. TD-2023

Was $9.95 Save $3

Nov. $6.95

ECONOMY ATTACHE CASE

Cat. HB-6352

Was $59.95 Save $10 Now $49.95

OVERNIGHT DELIVERY

TELESCOPIC FLOOR MIC STAND

Cat. AM-4140

Normally $69.95 Save $20 Now $49.95

OVERNIGHT DELIVERY

DUOTECTOR PIR/MICROWAVE DETECTOR

The ultimate in burglar alarm PIRS.

Requires both the PIR & Microwave to be triggered at the same time, substantially reducing false alarms. 10 METRE RANGE - MADE IN JAPAN

'96 Price $99.50 '98 Price $69.50

November Price $59.50 ea

Buy 4 for $220 Cat. LA-5012

SOLAR PANEL CHARGER REGULATOR

Regulate the charge going to a battery being charged by a solar panel. 12V DC 2A rated. See '98 Cat. page 85 for full details.

Cat. MP-3120

Was $79.95 Save $20

Nov. $59.95

6V 110MA NICAD CHARGER

Runs on 240V. Arlec brand. Super special.

Cat. MB-3506

Was $9.95

Nov. $5 **Save $4.95**

IEC EMI POWER LINE FILTER

Rated at 3A. See Cat. page 98 for details.

Cat. MS-4002

Was $12.95

Nov. $8.95 **Save $4**

0 to 30VDC/0 to 2.5A Digital Variable Lab Power Supply

Cat MP-3082

was $229

NOW $199

save $30

DESK MOUNT MAGNIFIER LAMP

A great tool to assist in PCB assembly & inspection, jewellers, stamp/coin dealers etc. Cat. QM-3525

ONLY $149.50

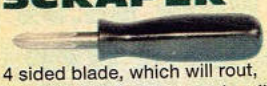
FLEXIBLE COMBINATION WRENCH SET

Set of 6 tools. Supplied in a vinyl carry pouch. Sizes are: 8x9, 10x11, 12x13, 14x15, 16x17 and 18x19mm

Cat. TD-2110 **Was $32.95**

Nov. $23.95 Save $9

4 BLADE SCRAPER



4 sided blade, which will rout, punch, shape, scrape and scribe. Ideal for hobbyists.

Cat. TD-2118 **Was $5.50**

Now $2.75

Save $2.75

NEW SPEAKER BOOKS

THE LOUDSPEAKER DESIGN COOKBOOK

The ultimate source for everything you need to know to build that dream loudspeaker for your home, your car, or your new home theatre. Softcover 28 x 22cm 165 pages. Cat. BA-1400 **$69.95**

LOUDSPEAKER RECIPES BOOK 1

This book is a complete guide showing you how to build four, easy to construct, fully tested, two-way loudspeaker systems that perform brilliantly at a surprisingly modest cost. Softcover 28 x 22cm 112 pages. Cat. BA-1002 **$49.95**

ULTIMATE AUTO SOUND

A must for sound enthusiasts who are serious about the quality of sound in their car, van, or truck. Softcover 27 x 21cm 99 pages. Cat. BA-1412 **$19.95**

LOUDSPEAKER PROJECT #1

A great guide to building 19 top quality loudspeaker designs. Softcover 27 x 21cm 89 pages. Cat. BA-1410 **$15.95**

BULLOCK ON BOXES

This book is a must for the serious enthusiast wanting to custom design their own speaker boxes. Softcover 28 x 22cm 74 pages. Cat. BA-1408 **$24.95**

THE ELECTROSTATIC LOUDSPEAKER DESIGN COOKBOOK

A complete guide covering all aspects of electrostatic speaker design and construction including theory with clear, concise explanations, circuit diagrams and construction details. Softcover 27 x 21cm 202 pages. Cat. BA-1404 **$69.95**

THE ELECTROSTATIC LOUDSPEAKER DESIGN & CONSTRUCTION

Intended for the audio amateur, musician or craftsman, this book is a 'how to' guide with step-by-step for building full range electrostatics. Softcover 25 x 18cm 242 pages. Cat. BA-1406 **$39.95**

AUDIO AMATEUR POWER AMP PROJECTS

Twenty-six of the most requested articles on power amplifier projects which appear in Audio Ameateur Magazine from 1970 -1989. Comprehensive construction details with all specifications and calculations. Softcover 28 x 22cm 207 pages. Cat. BA-1418 **$45.00**

ELECTRONIC CLEANING SOLVENT COMPUTER CLEAN

This is EXACTLY the same as our standard Electronic Clean Solvent (Cat. NA-1004 $9.75) which is ideal for use on delicate electronic, electrical and precision mechanical assemblies (ie tuners, switches, plugs, sockets, relays, pots etc.). A highly efficient fast drying solvent of high purity.

Cat. NA-1005 **Normally $9.75**

This Lot Only $3.99ea

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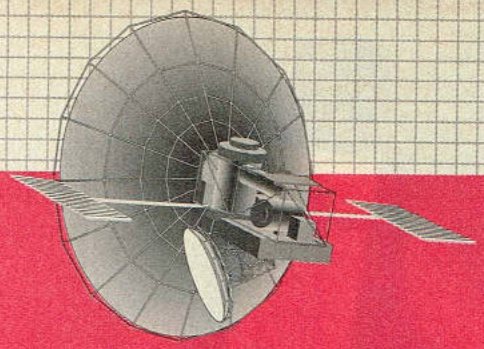
SATELLITE WATCH



Compiled by GARRY CRATT*

Changes on PAS-2 for CNN & NHK

PAS-2 (169°E)

As predicted, CNN moved to 3905MHz vertical polarisation on July 15, vacating the previously occupied transponder (3965MHz horizontal). There are now no horizontally polarised analog signals on this satellite.

NHK continue to broadcast in analog on 4055MHz vertical polarity and has extended the period of parallel operation to at least this month, according to sources in Japan. The free-to-air digital service "NHK World" is also running on 4035MHz horizontal, SR 26470, FEC 3/4. NHK "World Premium Service" operates using PowerVu conditional access on the same transponder. Costs for the "Premium" service are rumoured to be $2350 for the Scientific Atlanta IRD required, plus a 3000-Yen monthly subscription fee.

Subsequent to the closure of the dedicated "NBC Asia" channel, a new bouquet has appeared at 4093MHz (SR 29473, FEC 3/4, vertical polarity). The new channels include the National Geographic Channel and CNBC Asia. Versions of these channels destined for Indonesia, Taiwan and Australia are carried in the 6-channel bouquet.

Since July, a new bouquet has been testing on this satellite on 3778MHz vertical polarity, SR 6619, FEC 2/3, no CA, NTSC. The new channels list as: ART America, ART movies, RAI International, ART Australia, LBC America, LBC Australia and MCM The Music Channel. At the time of writing, only LNB America was active.

GMA Update

Email correspondence with GMA indicates that the broadcaster is trying to work out a way of getting their signal back to Australia. The present service on the Agila satellite at 146° is barely receivable in the eastern states of Australia or New Zealand. The broadcaster is now aware in no uncertain terms of the number of viewers affected in Australia, estimated to be several thousand.

Asiasat 2 (100.6°E)

TVSN has ceased operations on this satellite, apparently as a result of the Asian economic crisis. The program was uplinked from Epping, a suburb of Sydney.

Hallmark movie channel has also moved from this satellite, and now appears on Apstar 2R in scrambled format. KIBC, broadcast from the Philippines with Hallmark, remains on Asiasat 2.

THAICOM 2/3 (78.5°E)

Despite a low look angle to viewers along the east coast (typically 6° above the horizon), strong signals can be observed using a 2.3m dish. Analog signals include Thiacom tests which can be found at 3650MHz and 3686MHz, horizontal polarity. Digital signals include Thai TV5 and Maharishi Veda Vision, broadcast in an MCPC bouquet on 3600MHz, horizontal polarity, SR 26662, FEC 3/4.

Cakrawarta 1 (107.7°E)

Indonesia's own satellite (Cakrawarta 1) has begun S band testing. The downlink frequency is 2540MHz, SR 20000, FEC 5/6. Initial footprint data indicates a 3m dish will be required to receive this satellite along the east coast of Australia. Indonesian officials are advising that the satellite may not begin commercial operations for some time, due to the general economic situation in Indonesia.

In addition, press reports in August indicate that a solar storm has damaged the spacecraft's electrical system, reducing the expected lifetime of the satellite to just seven years. The satellite will be unable to achieve full operating power during the solar outages which occur for a few days in March and September each year.

This means that the planned migration of the current C-band "Indovision" pay TV service, carried on the Palapa C2 satellite, could be delayed some months.

Intelsat 702 (177°E)

Space TV, a Taiwanese pay TV broadcaster operating for the last year on 12.612GHz (SR 26694, FEC 3/4 horizontal polarity), has left this satellite. This means the only free to air broadcaster is Thai TV5, who have changed their operating parameters to 12.650GHz, SR 17800, FEC 1/2. The service is broadcast in PAL and requires a 1.2m dish along the east coast of Australia for good reception. **SC**

*Garry Cratt is Managing Director of AvComm Pty Ltd, suppliers of satellite TV reception systems. Phone (02) 9949 7417. http://www.avcomm.com.au

An FM transmitter for musicians

These three FM transmitters all use the same circuit but you can vary the construction to suit your application. One unit is configured as a guitar FM transmitter, one as a handheld wireless microphone and the other for use with a lapel microphone.

Design by BRANCO JUSTIC

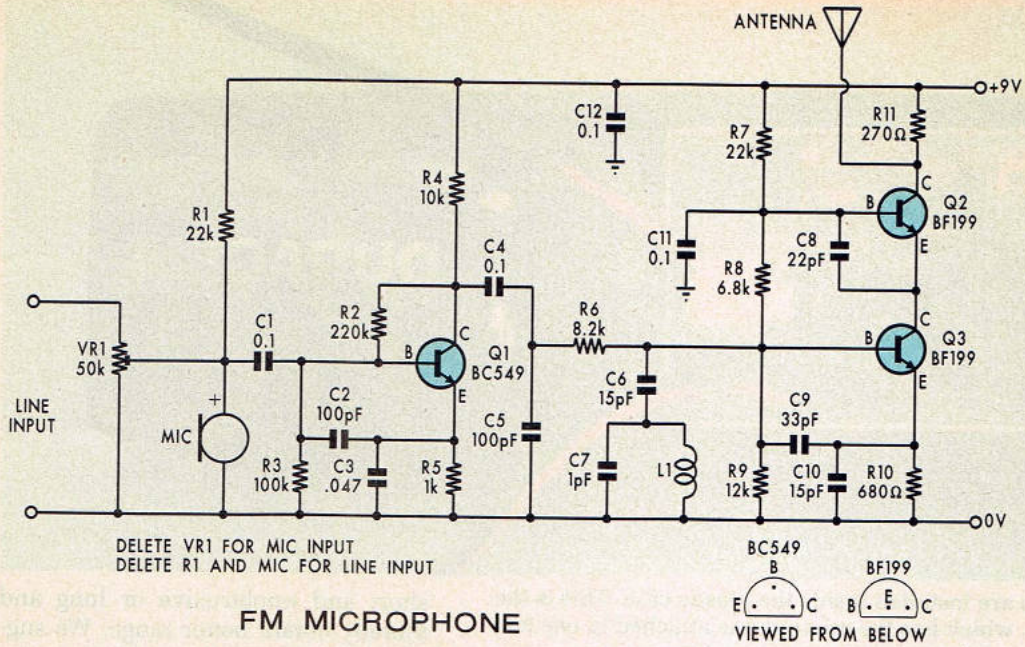
This circuit is not new, having been featured previously in the October 1993 issue of SILICON CHIP. However, there have been a couple of minor circuit modifications to tweak the performance, while the PC board has been redesigned to make the unit easier to build.

In particular, the PC board is now single-sided, whereas the earlier Mk.1 version used a double-sided PC board that required soldering on both sides.

As with the previous design, the new "FM Microphone Mk.2" was designed by Oatley Electronics and they will be making available a complete kit of parts. So which version should you order? Well, you don't have to worry about that because the kit contains all the necessary parts for each version. It even includes three labels; you simply use the one that's right for your application.

The differences between the three units are really quite minor. In fact, the two wireless microphone versions are identical except that the handheld unit has the microphone attached to the case while the second unit has the microphone attached to a lapel clip. Fairly obviously, the microphone is left out of circuit for the guitar FM transmitter unit and the guitar provides the input signals instead.

Physically, all three versions are housed in the same plastic case, which measures 125 x 40 x 24mm (length x



FM MICROPHONE

Fig.1: the circuit is based on three transistors (Q1, Q2 & Q3). Q1 functions as an audio preamplifier, while Q2 & Q3 form a modulated oscillator with good isolation between the antenna and the tank circuit (L1 and its parallel 1pF capacitor).

width x depth). As shown in one of the photos, a standard 9V alkaline battery sits at one end of the case, while the PC board occupies the other end. A miniature slide-switch on the side of the case switches the power on and off.

Performance

As before, this FM transmitter design features excellent frequency stability. Some FM wireless microphones can be temperamental devices to use, particularly as far as frequency drift is concerned and there are several causes for this. The first of these is due to a drop in the supply voltage as the battery ages. The second is due to capacitance effects between the user's body and the dangling antenna. Third, and not usually recognised, is drift due to change in temperature.

When you set up an FM wireless microphone to operate at a particular frequency, say 95MHz, you don't expect it to drift much. If it only drifts by a small amount, the AFC (automatic frequency control) circuits of your FM tuner should cope with the change in frequency so that the signal is always received clearly. But there is a limit to the AFC range of any FM tuner (perhaps ±100kHz) and beyond that, the signal will start to distort badly and ultimately, will not be received at all.

That is why drift caused by body capacitance can be so annoying as it varies all over the place.

This design does not have these problems. We tested it in a number of ways, including heating up the PC board with a hot air gun and even then, drift was not a problem. Nor do power supply variations worry it. In fact, drift due to supply voltage variations of 1V for a 9V supply is quoted as less than 0.03%.

The operating range is quoted as better than 100 metres with a good quality tuner. Other relevant specifications are: signal-to-noise ratio >60dB; pre-emphasis 50ms; frequency response 40Hz to 15kHz.

Circuit details

Fig.1 shows the circuit which uses three NPN transistors. Transistor Q1 (BC549) is an NPN audio preamplifier stage which steps up the input signal from the electret microphone or from the guitar. The output from Q1 (at the collector) is then coupled via a 0.1µF capacitor and an 8.2kΩ resistor to the

Parts List

1 PC board (available from Oatley Electronics)
1 electret microphone insert
1 9V alkaline battery
1 9V battery snap
1 subminiature former with core, can and base (L1)
1 SPST miniature slide switch (S1)
1 50kΩ trimpot (VR1)

Semiconductors
1 BC549 NPN transistor (Q1)
2 BF199 NPN transistors (Q2,Q3)

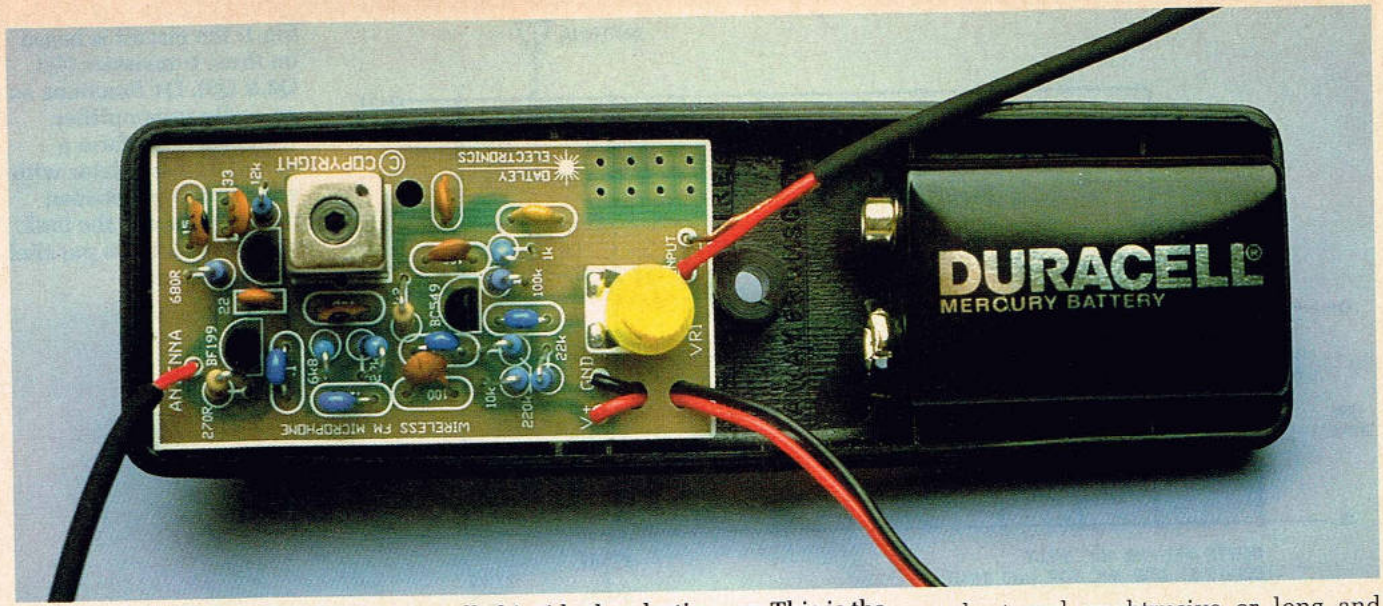
Capacitors
4 0.1µF monolithic
1 0.047µF monolithic
2 100pF ceramic
1 33pF ceramic
1 22pF ceramic
2 15pF ceramic
1 1pF ceramic (see text)

Resistors (0.25W, 1%)

1 220kΩ	1 8.2kΩ
1 100kΩ	1 6.8kΩ
2 22kΩ	1 1kΩ
1 12kΩ	1 680Ω
1 10kΩ	1 270Ω

Kit Availability

This FM wireless microphone/transmitter has been produced by Oatley Electronics who own the design copyright. They can supply a complete kit of parts, as follows: PC board, all on-board parts, a unidirectional microphone with clip, a surplus plastic case, slide switch, battery clip and stickers. The price is $17.00 plus $5.00 for postage & packing. The company's address is PO Box 89, Oatley, NSW 2223. Phone (02) 9584 3563 or fax (02) 9584 3561.



This view shows how the parts are installed inside the plastic case. This is the handheld microphone version, which has the microphone attached to one end of the case.

base of Q3 which is the lower half of a cascode oscillator circuit. The cascode configuration, involving Q2 & Q3, is the secret of the circuit's excellent rejection of body capacitance effects on the operating frequency.

The operating frequency is set by a parallel LC network comprising the 1pF capacitor and adjustable coil L1 at the base of Q3. By virtue of the cascode configuration, the components which set the operating frequency are well and truly isolated from the antenna which is connected to the collector of Q2. L1 allows the operating frequency to be set to a vacant spot on the FM broadcast band (88-108MHz).

Building it

Fig.2 shows the assembly details for the PC board. The assembly is a pretty straightforward process; it's simply a matter of inserting and soldering each component in turn. The most important point to remember is to keep all the component leads to an absolute minimum length. Because the circuit operates in the FM broadcast band, even short lead lengths have significant inductance and this can prejudice the performance.

If you intend building either of the FM microphone versions, leave trimpot VR1 out. Conversely, for the guitar transmitter version, include VR1 but delete the 22kΩ resistor on its wiper and delete the microphone.

Note that all the resistors are soldered "end-on" to save space on the PC board. The length of the antenna wire is up to you. You can have it short and unobtrusive or long and thereby obtain better range. We suggest a length of about 65-90cm for good range; any longer and the range will be reduced.

Once all the parts have been soldered to the board, you are ready to test it and set the operating frequency. For this you need an FM radio. Connect the 9V battery and turn on your FM radio. Now tune across the band until the speaker squeals. The frequency on your dial is now the operating frequency of the circuit.

If you want to adjust the frequency of operation, you reverse the above process. Tune your radio to a vacant part of the band – let's say this frequency is 99MHz. All you should be getting is hiss from the loudspeaker of the radio. Now adjust the slug of coil L1 until you get a continuous squeal from the radio. That's it, the job is complete.

In more detail, the tuning range of

Resistor Colour Codes

No.	Value	4-Band Code (1%)	5-Band Code (1%)
1	220kΩ	red red yellow brown	red red black orange brown
1	100kΩ	brown black yellow brown	brown black black orange brown
2	22kΩ	red red orange brown	red red black red brown
1	12kΩ	brown red orange brown	brown red black red brown
1	10kΩ	brown black orange brown	brown black black red brown
1	8.2kΩ	grey red red brown	grey red black brown brown
1	6.8kΩ	blue grey red brown	blue grey black brown brown
1	1kΩ	brown black red brown	brown black black brown brown
1	680Ω	blue grey brown brown	blue grey black black brown
1	270Ω	red violet brown brown	red violet black black brown

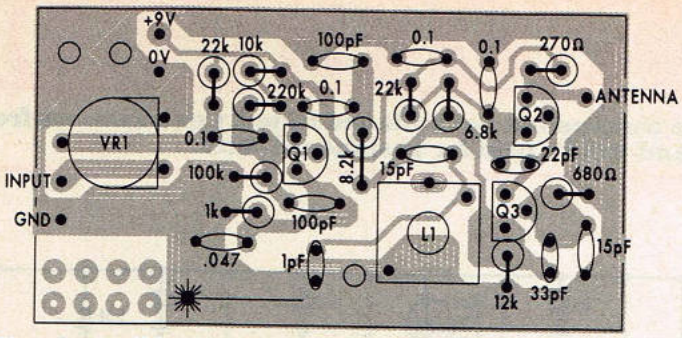


Fig.2: keep all leads as short as possible when installing the parts on the PC board. Note particularly that Q1 is a BC549 type and is different to Q2 and Q3 which are both BF199s.

the wireless microphone can be adjusted upwards by removing the 1pF capacitor. With this capacitor in circuit, the tuning range of L1 will be in the lower region of the FM band: from below 88MHz to about 102MHz. With the 1pF capacitor in circuit, the tuning range will be from about 95MHz. You have to decide which portion of the band you want your circuit to operate in and then pull the capacitor out or leave it in. You then adjust the slug of L1 as described above.

After you have adjusted coil L1 to your satisfaction, move the microphone well away from the radio so that the acoustic feedback squeal and distortion is no longer apparent. You should now be able to speak into the microphone and your voice should come from the radio with clean reproduction.

You can now complete the construction by wiring up the on-off switch and then installing the board and battery inside the plastic case – see photos. The PC board is positioned at the top of the case and is secured using silicone sealant. You will have to drill a hole in the end of the case to accept the lead for the guitar or microphone (lapel version).

If you intend building the handheld microphone version, you will need to mount the microphone on the end of the case before installing the PC board. This will involve drilling a small pilot hole (with the two halves of the case attached together) and then carefully reaming the hole to size. Once this has been done, separate the two halves of the case and secure the plastic base of the microphone to the bottom half only using silicone sealant.

Capacitor Codes

	Value	IEC Code	EIA Code
❑	0.1µF	100n	104
❑	.047µF	47n	473
❑	100pF	100p	101
❑	1 33pF	33p	33
❑	22pF	22p	22
❑	15pF	15p	15
❑	1pF	1p0	1

The PC board can then be installed, as before.

You will also have to drill a small hole at the other end of the case for the antenna lead. Drill this hole in the bottom half of the case only, then make a small cutout for the slider of the plastic switch. This cutout can be made by drilling some small holes and then filing the hole to shape.

The switch is also secured to the side of the case using epoxy resin. Be careful not to get any of the epoxy inside the switch – it will be ruined if you do.

Also supplied with the kit is a small piece of 3mm-thick foam rubber. This should be attached to the bottom of the case at the end opposite the PC board. It's there to stop the battery from rattling around.

Once everything is in place, the two halves of the case can be secured together using the supplied self-tapping screw. This is installed from the back and screws into a central boss in the top half of the case. Finally, fit the appropriate front panel label and the job is complete. **SC**

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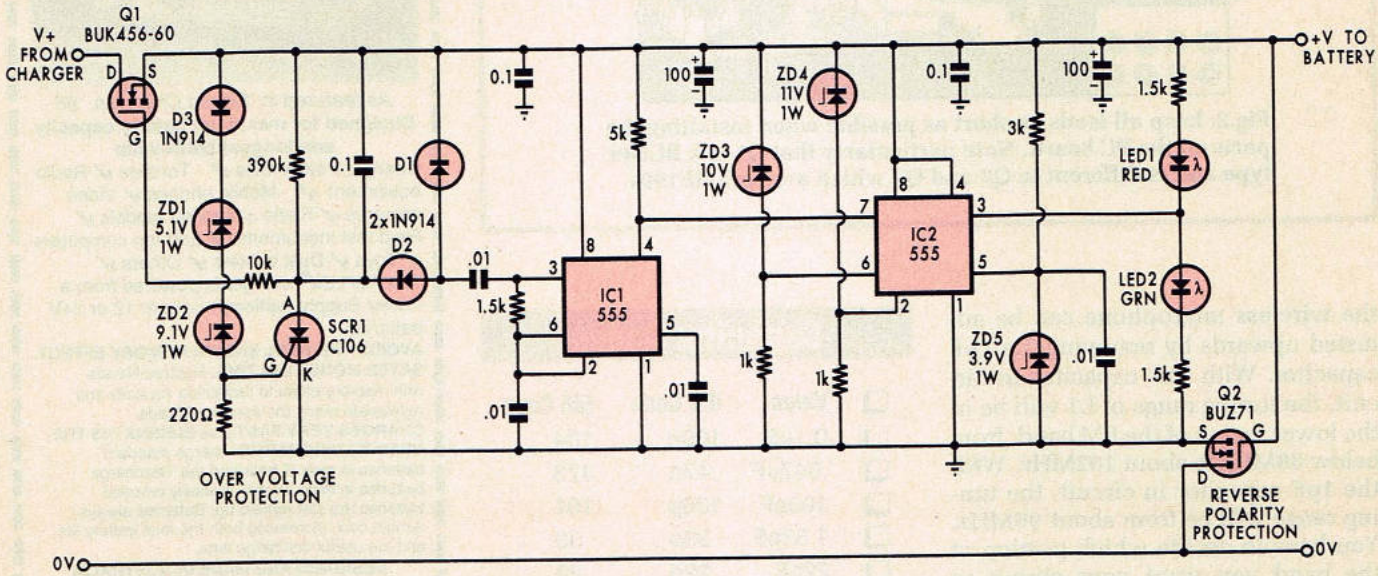
CIRCUIT NOTEBOOK

Interesting circuit ideas which we have checked but not built and tested. Contributions from readers are welcome and will be paid for at standard rates.



Regulator for a car battery charger

This regulator prevents a conventional battery charger from overcharging a 12V car battery. It is designed to have a maximum insertion loss of less than 0.2V.

To achieve this, the series control element is a BUK456-60 N-channel Mosfet (Q1) which has an ON resistance of 0.028Ω and a drain current rating of 52A. The circuit is suitable for chargers rated up to 8A. Depending on the rating, Q1 will require a minimal heatsink or none at all.

The Mosfet's gate requires a positive voltage with respect to its source and this is generated by a 555 oscillator (IC1) operating at 100kHz. It drives a voltage doubler using 1N914 diodes, D1 & D2.

A little used feature on the 555 timer is the reset pin 4 which stops its oscillating when it is pulled low. This is used to turn the Mosfet on and off as required.

The battery voltage is sensed by IC2, by means of zener diodes ZD3 and ZD4 connected to its pins 6 & 2. These make the circuit switch off at a battery voltage of 14V and switch on at 13V (or less). Pin 7, the discharge pin of IC2, stops IC1 from running by pulling pin 4 low.

Over-voltage protection for the circuit is provided by zener diodes ZD1 & ZD2, diode D3 and SCR1. If the input voltage from the charger exceeds 16V, SCR1 conducts to remove the gate voltage to Q1.

Finally, protection against reverse connection of the battery is provided by Mosfet Q2. With a normal battery connected, the gate of Q2 is positive with respect to its source and so it is turned on to provide the 0V return for the drive circuitry to Q1. However, a reverse connected battery reverses the gate voltage to Q2 and it turns off, killing the power to the circuit and no harm is done.

V. Erdstein,
Highett, Vic. ($45)

DTMF radio alarm system

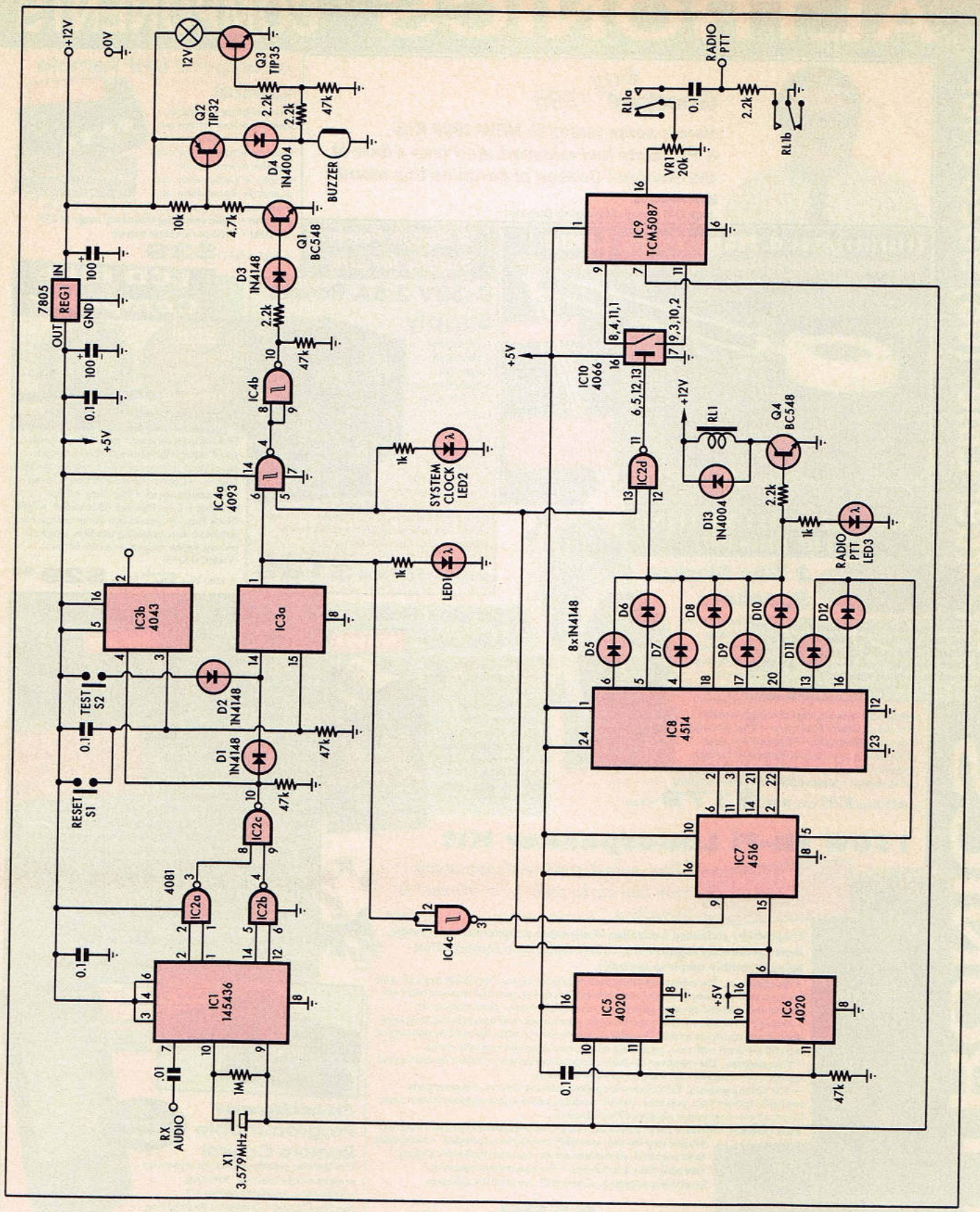
This system was designed to alert the operator of a steam boiler. A handheld radio fitted with a DTMF tone encoder is used by another person to sound the alert if steam pressure drops.

IC1 is a DTMF tone decoder with its input (pin 7) connected to the receiver. The BCD outputs of IC1a are fed via AND gate IC2 which gives a high output at its pin 10 when the DTMF character "7" is decoded. This logic high is latched through to pin 1 of IC3a to enable NAND gate IC4a. The same latched signal is inverted by IC4c to remove the reset signal on pin 9 of IC7.

IC5 and IC6 divide the 3.579545-MHz crystal frequency from IC1 down to 1.7Hz at pin 6 of IC6 and this is fed to pin 15 of IC7, to LED2, to pin 13 of IC2 and pin 5 of IC4a.

As a result, Q1 and Q2 will pulse the buzzer at 1.7Hz and Q3 will flash the lamp at the same rate, whenever the output of latch IC3 is high.

Whenever the reset pin 9 of IC7 goes from high to low, the 4516 counter will count up and its BCD output will cause the outputs of the 4514 BCD-to-decimal decoder IC8 to go high sequentially. About five seconds after IC7 has started to count, Q4 and relay RL1 are turned on via the gating diodes at the outputs of IC8. This relay causes the boiler room radio to send an acknowledging DTMF code for about three seconds. The DTMF code is generated by IC9.



The whole alarm system can be reset manually by a front panel mounted pushbutton switch, connected to the reset pins of IC3.

The manual test button bypasses the DTMF decoder but tests all other functions of the alarm system.

P. Howarth,
Gunnedah, NSW. ($45)

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Leo Simpson, Silicon Chip Magazine

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Silicon Chip, April '97

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Auto Ranging DMM
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- True RMS AC to 5kHz
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PC I/O Adaptor Kit

(See EA July '91)
Using this module you can computer control all kinds of things such as security systems, stage lighting, model railways, watering systems etc. The unit simply connects to a standard RS232C serial port on any PC. It has a 8 digital inputs controlling 8 outputs. A simple addressing systems allows multiple units to be "daisy chained" from a single RS232C port, expanding the number of inputs and outputs up to 64.

Combined, the K 2850 & the K 2852 Allow You to Turn Appliances On & Off with Your Computer!

K 2850 **$59**

Plugpack to suit M 9664 $14.50

Input Buffer & Relay Driver Kit

(See EA Feb '89) This is a companion kit for our I/O Adaptor kit (K 2850). It has four relay outputs and eight opto-isolated inputs. This kit contains all parts necessary to construct both the input and output stages. A Qbasic program listing is supplied to help you complete your project.

K 2852
$34.95

Beat Triggered Strobe Kit

Make your next party a real blast!

(See SC Aug '98) You've seen these in Nightclubs and rock concerts. Strobes add super lighting effects in darkened entertaining areas. It is sure to add tons of life to any party or B.B.Q. *Features* • Variable rate and sensitivity for beat settings • Line source inputs for beat triggering • Selectable beat / continuous functions • Easier to construct than earlier versions • Powered from a standard 240V mains source • MDF box, carpet, robust aluminium reflector *(unlike others on the market)* and all the necessary components for a single strobe model. Add a second tube option for twice the light!

K 5792
$159

K 5797 Two tube option $18.95

Sustain Unit Kit for Electric Guitars

(See SC Apr '98) A sustain unit can make your guitar sound a little more "live", by keeping the volume of a note at a constant level while the string resonance dies away. It's one of the most widely used guitar effects (FX), and this simple kit is a fraction of the cost of a commercial unit! It features adjustable attack and decay, a defeat switch and standard 6.35mm input/output jack sockets. Requires a 12V DC power supply. Supplied short form so you can build it into a custom case, if required.

Add sustain to your range of guitar FX at a fraction of the cost of a commercial unit!

K 5539 **$27.95**

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Turbo "Cool Down" Timer Kit

Tired of waiting for your turbo to cool down?

NEW!

(See SC November '98) Turbo charged engines must be run at idle for a few minutes to cool down after a long journey to avoid damage. This project allows your car to be run for a few minutes at idle speed so you can lock the car and leave it to turn off by itself. *Features:* • 90 second time-out • Under temperature disable • Reset switch • Robust flanged box • Simulated Ignition Cutout for immobiliser • No battery power drain once shutdown

Fantastic Christmas gift!

K 4060 **$29.95**

S 4335 Optional 30A Relay to suit $6.95

12 & 24V "Dual Mode" Battery Charger Kits

Excellent Christmas present for Dad!

(See SC Oct '98) One of the most glaring problems associated with inexpensive commercial chargers is that you cannot leave the battery connected to them for longer than necessary. Doing so causes a fire risk, not to mention reducing the life of your expensive battery. This unit is powered by 240V and will charge a flat lead acid battery at 2 A until fully charged. The charger will then keep the battery topped up by maintaining a small current (0.5A) to the battery. Supplied with all the components and an attractive housing.

This "smart" charger will not only keep your battery charged, but it will also extend the life of your battery!! (By not overcharging) Ideal for camping, boating, 4WD's or for a security system battery backup.

NEW!

K 4225 12V Model **$49.95**

K 4226 24V Model **$59.95**

"Wa-Wa" Pedal Kit

NEW!

Produce the sound that made Jimmy Hendrix famous with this inexpensive "Wa-Wa" pedal

(See Sept. SC '98)
The electronics of the "Wa-Wa" pedal shapes the guitar's output waveform to produce a "Wa" sound. Stepping on the pedal will vary the amount of "Wa" introduced into the guitar's output. This project contains all the parts required to construct the electronics portion of the pedal including the slider pot for the pedal housing and information on how to construct your own pedal. **Features:** • Virtually noise and hum free • Band Pass frequency : 50Hz to 2.8kHz • Bandpass Q : 4.35 to 4.76 from 100Hz - 20kHz • Bandpass adjustment with VC 16% • Bandpass frequency linearity with control pot <5% • Maximum input signal 220mV RMS • Frequency response -3dB @ 47Hz and 2.8kHz • Signal to noise ratio 78dB with 20Hz - 20kHz filter (at max input) • THD 0.3% @ 1kHz and 200mV input

K 5533 **$34.95**

12V Plugpack to suit M 9664 $14.50

Audio Pre-Amp for PC Sound Card

NEW!

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(See EA Sept. '98) As we all know, tape and phono players require equalisation that is not included in the software for burning CDs. This project provides stereo equalisation for tape/phono and microphone, plus basic mixing functions. **Features:** • Line output : 2V p-p @ 1kHz • Low Noise Magnetic Pickup preamp : full RIAA eq. 35dB gain @ 1kHz, input impedance 50k • Low Noise Microphone Preamp : selectable total effective gain of either 60dB or 50dB to suit microphone output. Response is flat within 2dB from 35Hz - 18kHz, input impedance 100k • Independent tape/line and microphone level controls, bass and treble controls, providing 12dB boost or cut @ 50Hz and 15kHz. • Attractive black powder coated sloping console case

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12V Plugpack to suit M 9664 $14.50

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NEW!

Improve your quarter mile time!!

(See SC Sept '98) Modern race cars have indicators to tell drivers when it is time to change gear and this can vastly improve racing times. The project provides an audible and visible indication that it is precisely the right time to change up a gear. *Features:* Adjustable change times (suits up to 5 spd g/box) Supplied shortform with no case

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RADIO CONTROL

BY BOB YOUNG

A mixer module for F3B glider operations; Pt.1

Last month, we described the operation of the basic controls on a typical F3B international class sailplane and outlined some of the parameters affecting the design of such a sailplane. In this article, we will present the design for an F3B mixer module for the Silvertone Mk.22 transmitter.

This is a single stick version of the Silvertone Mk.22 transmitter. It gives three-axis control (ailerons, elevator and rudder) via the knob on the stick.

This month we will look at a simple F3B mixer module to illustrate some of the techniques used to control an F3B glider. This will highlight the complex nature of the task. At the same time, I will attempt to break the circuit operation down to the smallest sub-module so that these building blocks may be applied to any transmitter utilising half-rail encoders such as the NE5044. The half rail encoder makes possible servo reversing, mixing, etc.

To begin with, this task is very definitely governed by the 90-10 rule, whereby 90% of the effort goes into achieving the last 10% of the result. Modern computer-based transmitters attempt to supply everything for everyone and in so doing, have often become burdensome to operate.

Frustration during programming is quite common and often the desired configuration cannot be achieved due to system limitations. The module to be described will plug into the Silvertone Mk.22 mixer expansion port (TB11) to convert it into a fully configured F3B transmitter with very little programming left for the operator.

In fact, all that is usually required of the operator is to set up the channel allocation and set the direction of travel on the servos.

However, by long experience I realise that there will always be someone who will require an extra 10 widgets or a relocated emfanger. So a very high degree of flexibility has been built into the PC board to give virtually no limit upon the mixing possibilities.

Multi-point mixing is available on all 24 channels with any channel able to be mixed with any other channel, if sufficient mixers are obtained. For those who take the trouble to understand the nature of the circuit presented and who are prepared to experiment, the possibilities are endless.

The standard Silvertone Mk.22 eight channel encoder PC board carries four free mixers (two inverting and two non-inverting) while the F3B module features eight mixers and two endpoint clamps, all of which may be operated in the pre-programmed or free mode. Thus there are twelve mixers available, which should be more than enough for the average F3B model.

Keeping it simple

The main difficulty facing the designer of any complex programmable system is keeping the programming simple and user friendly. This applies doubly to a discrete component system as the programming can very quickly become a nightmare of patch cords and wander leads.

The module presented here overcomes this problem with an extension of the original wander lead programming system. To find out more about this concept, the interested reader should refer to the articles describing construction and programming of the Mk.22 transmitter, published in June 1995 and March, April, May, June, July, August and October 1996 issues of SILICON CHIP.

This module is designed around a 28-pin socket that mates with the

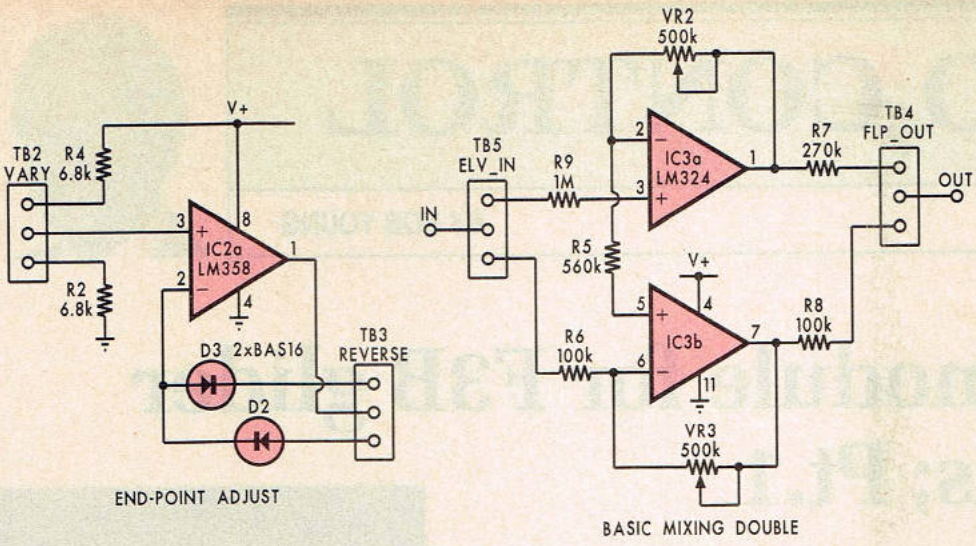


Fig.1: the F3B module is constructed out of op amp mixers arranged in matched pairs, one inverting and one non-inverting. An inverting mixer will reverse the direction of rotation of the servo whereas a non-inverting mixer will not. Two end point clamps are also provided (see text).

mixer expansion port (TB11) on the standard Mk.22 transmitter encoder board. When used in the pre-programmed mode, simply plugging this module into TB11 converts the Mk.22 into a fully configured F3B transmitter. It features CROW landing configuration, launch camber and a novel knob-controlled camber vary facility that allows the wing section camber to be controlled from the front panel in flight.

In this instance, one of the standard Mk.22 auxiliary control knobs is programmed as a camber vary control.

There is also a flap/elevator compensation mix and a "V" tail mixer set. This completes the basic pre-programmed instruction set and all of these may be preset or switched in or out from the front panel. Sufficient free mixers are available to add in snap flap, ailerons mixed into flaps and coupled aileron/rudder, thus completing the full F3B complement of controls.

The PC board is small enough to be hard wired into other brands of transmitters using a flexible lead. TB11 contains all mixing points that may be required for other Silvertone modules still in development. However the F3B module only uses about half of these so there are not a lot of connections to make. If more mixers are required, sufficient information will be given in this series to develop your own circuit board layout.

The Mk.22 encoder is a voltage-driven unit using op amps and multiplexers, with the op amps referenced to a half rail (+2.5V) divider. Wander lead programming is used exclusively, with all controls fitted with identical 3-pin sockets to mate with 3-pin plugs on the encoder PC board. Programming is simple and once one channel is mastered, the rest is simple as all 24 channels follow the same layout and rules.

Mixing can be achieved by simply coupling one channel to another with resistors but if this is done, reverse mixing will occur in proportion to the ratio of the series mixing resistor. Therefore it is necessary to insert a buffer amplifier in each mixer lead to isolate the stages.

However there are applications where reverse mixing may be useful so keep the resistive mixing technique in mind. Likewise, channels may be run in parallel by using a "Y" lead on the input harness. In this case, variable gain is available on each channel, allowing servo travel to be matched precisely.

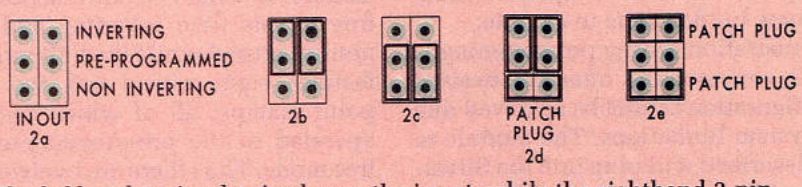
Op amp mixers

Essentially the F3B module is constructed out of op amp mixers arranged in matched pairs (one inverting and one non-inverting, as shown in Fig.1. An inverting mixer will reverse the direction of rotation of the servo whereas a non-inverting mixer will not. Two end point clamps are provided and these provide a special feature that we will look at later.

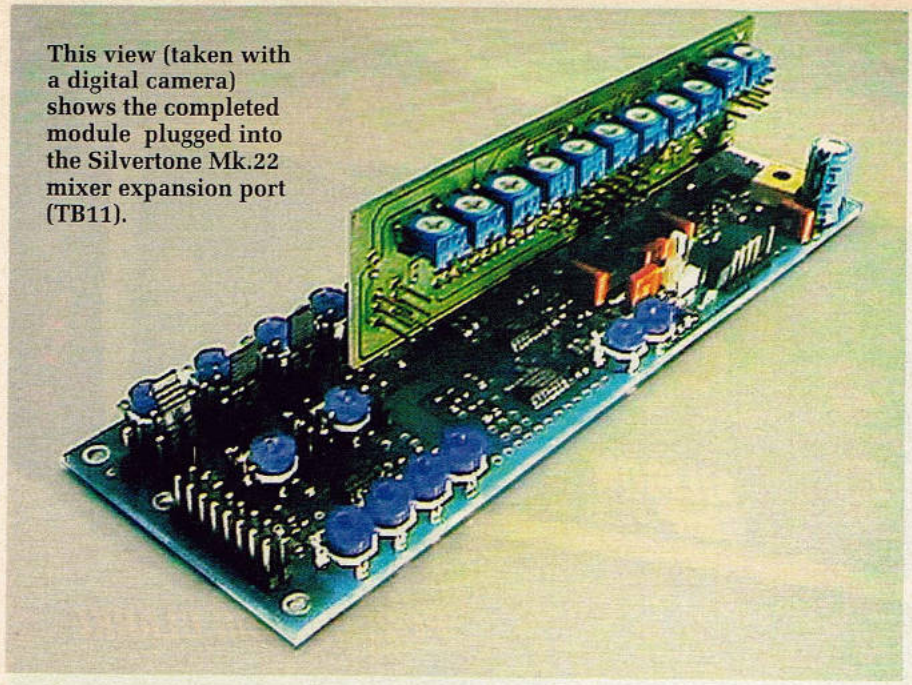
A high level of consistency has been achieved in the physical layout with the original Mk.22 encoder and as already mentioned, the 3-pin programming plug has been retained. A novel touch in this module is the way these programming pins are arranged. Each pair of mixers share a common 3-pin input and output plug pair arranged as shown on Fig.1.

Not only is this arrangement simple to program but by rotating the wander lead by 180 degrees, each mixer is available for independent use; a novel touch.

As indicated on Fig.1, the pre-programmed input and output leads are linked to the centre pin of each 3-pin plug. For the sake of simplicity, the lefthand 3-pin plug is always the input and the righthand 3-pin plug is always the output. This is shown in



The lefthand 3-pin plug is always the input, while the righthand 3-pin plug is always the output. This is shown in Fig.2(a), with the inverting mixer on the lower half. Thus, to reverse the servo direction, all that is required is for the micro-shunts to be placed on the inverting or non-inverting pins, as shown in Fig.2(b) and Fig.2(c). Fig.2(d) and Fig.2(e) show the patch plug options.



This view (taken with a digital camera) shows the completed module plugged into the Silvertone Mk.22 mixer expansion port (TB11).

Fig.2(a), with the inverting mixer on the lower half. Thus to reverse the servo direction all that is required is for the micro-shunts to be placed on the inverting or non-inverting pins, as shown in Fig.2(b) and Fig.2(c). The micro-shunts may also be replaced with a DPDT switch for remote switching. The micro-shunts are the same as shorting links commonly used in personal computers.

You will note that in Fig.2(b) and Fig.2(c), one input and one output pin are left free and by using one of the patch leads described in the October 1996 issue this free mixer may be used for other tasks if required – see Fig.2(d). Alternatively, the pre-programming can be completely disabled by using both mixers as independent units, as in Fig.2(e).

If the application calls for a dedicated installation, the header pins can be dispensed with and all programming points may be hard-wired to remote switches.

Referring back now to Fig.1, op amps IC3a & IC3b are two sections of an LM324. IC3a is connected as a non-inverting mixer while IC3b is an inverting mixer.

One of the problems with this arrangement is the fact that the gain (servo travel) control on the non-inverting mixer is not as flexible as that of the inverting mixer. The inverting mixer gives excellent control from zero to full travel whereas it is not possible to reach zero gain on the non-inverting mixer. Also the gains of the two mixers are not matched and the input and output voltages must be adjusted with series resistors. Even so, the end result is a matched pair over most of the useful range of servo travel.

VR2 and VR3 are the master gain controls and provide the servo travel adjustments (ATV – Adjustable Travel Volume). TB4 and TB5 are the input/output connectors and are physically arranged as in Fig.2(a).

That as is all there is to the basic mixer module. In the full circuit to be presented next month, you will find this module repeated four times with slight variations to suit the programming requirements.

End-point adjustment

The end point adjustment performs a special function in that it acts as a clamp or brake upon the servo, stopping it at a preset point in its travel. In the full module, this is used to clamp servo travel at somewhere around neutral and performs the camber control.

One of the problems encountered in the discrete encoder is that mixing is referenced to neutral which is the half-rail position. As the servo travels further away from neutral, the mixing becomes more noticeable. Now with flaps in an F3B module, mixing is applied both to and from the flap control which is usually the throttle lever on the transmitter. Thus if the flap lever full travel end-point is used as the flaps-up position, some unwanted mixing will appear in the flaps.

To prevent this, the end-point clamp is applied to the flap control. This limits the voltage swing at TB11 to the mid-rail voltage, which makes the "flaps up" position servo neutral.

Thus when moving the flap lever past neutral, the servo will stop at neutral as the lever travels to the full position. In other words, the last half of the flap lever travel is lost.

This provides a very interesting feature in the Mk.22 for if we plug the auxiliary potentiometer on the front panel onto TB2 of the endpoint module, we now have a very effective camber control. This may be adjusted in flight to optimise the wing camber to the conditions of the day. Again, this is a very novel feature and something which cannot be obtained in a computer-programmed setup.

Auxiliary pot setting

The setting on the auxiliary pot will define the flaps up position and this may be varied both above and below the neutral flap location. This will provide reflex or camber to the wing airfoil to the deflection best suited to the day.

Alternatively, the camber may be switched in preset amounts by arranging the correct voltages to pin 3 of IC2a. R2 and R4 set the potentiometer sensitivity; the larger the value, the less sensitive the potentiometer.

TB3 provides a simple reverse for the endpoint adjustment. By moving the micro-shunt on TB3, the polarity of the diode is reversed and thus the endpoint adjustment is applied to either the high or low end as required.

The biggest problem in designing a flexible system is that the designer must allow for the placement of servos in the model. There is absolutely no way of knowing which direction the servo will travel in, so allowance must be made for servo reversing in all modules. This virtually doubles the complexity of any design and can be quite a nuisance at times. Lots of early computer transmitters insisted on defined servo placements and were somewhat restrictive as a result.

These modules can be used with most brands of transmitters featuring the half-rail encoder. Next month we will present the full circuit and construction of the module. **SC**

Pt.2: By JOHN CLARKE

AC millivoltmeter measures down to one microvolt

If you need to measure wideband audio signals up to 200kHz and down to around 1μV, this project is for you. Last month we presented the operating features and circuitry. This month we present the construction and setting up details and give some practical tips of how to use the unit when testing audio equipment.

OUR NEW AC Millivoltmeter has been designed for ease of construction and a minimum of internal wiring. To facilitate this, we have produced a front panel PC board onto which mount the switches, potentiometer and input sockets. This board is soldered to the main PC board to complete all the connections between them.

Construction of the AC Millivoltmeter involves assembly of the PC boards, drilling out the front and rear panels of case, mounting the hardware and a small amount of wiring.

Most of the components for the AC Millivoltmeter are mounted on the two PC boards. The main PC board is coded 01510981 and measures 212 x 142mm while the front panel PC board is coded 01510982 and measures 202 x 73mm. The two PC boards are soldered together at right angles and they fit in a plastic instrument case measuring 260 x 190 x 80mm.

You can begin construction by checking the PC boards for any shorted or broken tracks and for undrilled holes. The holes for the rotary switches on the front panel PC board and the

fuse clips (F1) on the main PC board should be drilled out to 1.5mm (1/16"). Also, there should be 3mm (1/8") holes for the corner mounting positions on the main PC board. The holes for the PC stakes should be a tight fit before they are soldered, so that they are not likely to loosen when wires are subsequently soldered to them.

Start assembly of the PC boards by inserting all the links and resistors. The component overlay for the front panel board is shown in Fig.1, while Fig.2 has all the details for the main board. Table 1 shows the resistor colour codes, to help you select the correct value. Alternatively, you can use a digital multimeter to measure each resistor before it is inserted.

Attenuator resistors

The resistors for the attenuator switch are mounted on both sides of the PC board. Insert the 100kΩ, 10kΩ, 1kΩ, 100Ω, 10Ω and 2.2Ω resistors into the allocated positions from the front of the PC board and solder in position. Then cut the leads at the back of the board. The 8.2MΩ, 820kΩ, 82kΩ, 8.2kΩ, 820Ω and 2.2Ω resistors mount on the copper side of the PC board directly behind the previously mounted values.

You will need to insert PC stakes at all wiring positions on the main PC board. There are four more mounted near IC1 to support the PC board shields. On the front panel PC board, stakes should be inserted at the input and oscilloscope output terminals, for switch S4, for pot VR4 and at the wiring points for IC8.

Mount the PC stakes associated with IC8 from the rear of the PC board so that they do not protrude too far on the component side. This must be done to provide clearance for the panel meter. Also there are three PC stakes on the front panel board for securing the shields which we'll talk about later.

Next, insert the ICs making sure that you place them in their correct positions with the orientation as shown. All ICs on the main PC board are oriented in the same direction. Diodes D1-D8 and ZD1 can then be mounted, paying attention to their orientation. REF1 can also be mounted next, as well as the two regulators REG1 & REG2. Note that the 7815 (REG1) is located closest to the edge of the PC board.

You can insert the capacitors next.

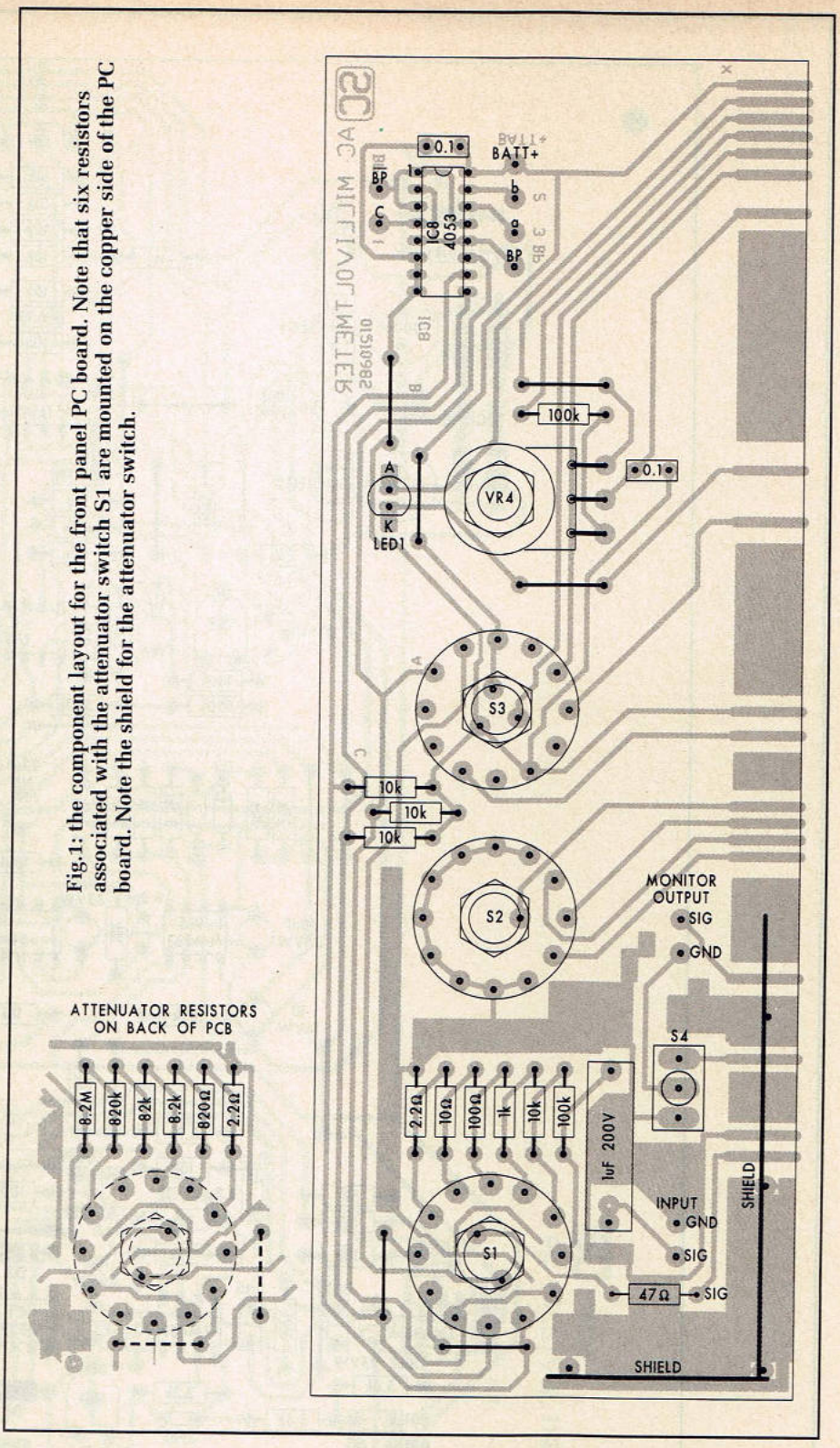


Fig.1: the component layout for the front panel PC board. Note that six resistors associated with the attenuator switch S1 are mounted on the copper side of the PC board. Note the shield for the attenuator switch.

Table 2 shows the IEC and EIA codes which may be on the MKT and ceramic types. The electrolytic types must be inserted with the correct polarity although that is not important with the bipolar (BP) or non-polarised (NP) types.

Next, insert all the trimpots. Make sure you insert each one in its correct place. Often these will be marked with EIA codes rather than the resistance value. Table 3 shows the codes.

The fuse clips are best inserted with the 2AG fuse clipped between them

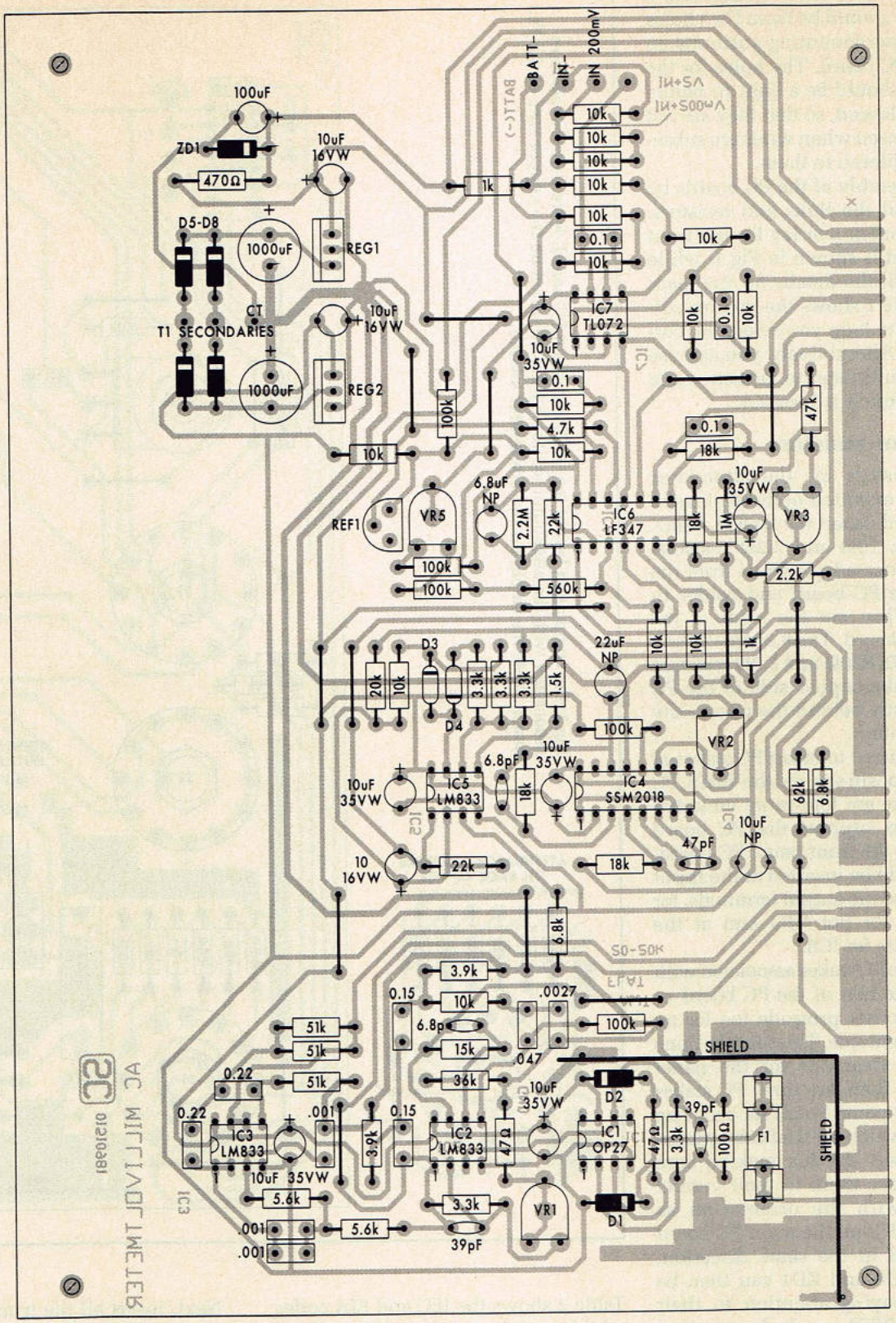


Fig.2: this is the component layout for the main PC board. Note that those capacitors marked "NP" are non-polarised and may be installed without regard for polarity; ie, they can go in either way around. A shield must be installed, as shown in the righthand bottom corner, to prevent hum and noise pickup by op amp IC1.

Resistor Colour Codes

No.	Value	4-Band Code (1%)	5-Band Code (1%)
1	8.2MΩ	grey red green brown	grey red black yellow brown
1	2.2MΩ	red red green brown	red red black yellow brown
1	1MΩ	brown black green brown	brown black black yellow brown
1	910kΩ	white brown yellow brown	white brown black orange brown
1	820kΩ	grey red yellow brown	grey red black orange brown
1	560kΩ	green blue yellow brown	green blue black orange brown
7	100kΩ	brown black yellow brown	brown black black orange brown
1	82kΩ	grey red orange brown	grey red black red brown
1	62kΩ	blue red orange brown	blue red black red brown
3	51kΩ	green brown orange brown	green brown black red brown
1	47kΩ	yellow violet orange brown	yellow violet black red brown
1	36kΩ	orange blue orange brown	orange blue black red brown
2	22kΩ	red red orange brown	red red black red brown
1	20kΩ	red black orange brown	red black black red brown
4	18kΩ	brown grey orange brown	brown grey black red brown
1	15kΩ	brown green orange brown	brown green black red brown
16	10kΩ	brown black orange brown	brown black black red brown
1	8.2kΩ	grey red red brown	grey red black brown brown
2	6.8kΩ	blue grey red brown	blue grey black brown brown
2	5.6kΩ	green blue red brown	green blue black brown brown
1	4.7kΩ	yellow violet red brown	yellow violet black brown brown
2	3.9kΩ	orange white red brown	orange white black brown brown
5	3.3kΩ	orange orange red brown	orange orange black brown brown
1	2.2kΩ	red red red brown	red red black brown brown
3	1kΩ	brown black red brown	brown black black brown brown
1	820Ω	grey red brown brown	grey red black black brown
1	470Ω	yellow violet brown brown	yellow violet black black brown
2	100Ω	brown black brown brown	brown black black black brown
3	47Ω	yellow violet black brown	yellow violet black gold brown
1	10Ω	brown black black brown	brown black black gold brown
2	2.2Ω	red red gold brown	red red black silver brown

first. Push the clips into the holes in the PC board as far as they can go before soldering them into place.

Rotary switches

You will need to cut the shafts for the three rotary switches to a length of 10mm while the potentiometer (VR4) shaft should be cut to a length of 15mm.

Before the switches are installed, you need to set them for the number of positions required; ie 6-position, 3-position or whatever. This is done by first removing the nuts for each rotary switch and taking out the locking pin washer. Rotate each switch shaft fully anticlockwise. With switch S1, insert the locking pin washer in the "6" position and replace the nut. Then check that this switch only rotates to six positions. Similarly, switch S2 has its locking tab washer inserted in the "3" position so that it can be rotated to three positions. Switch S3 has its locking tab washer inserted in the "2" position for 2-position operation.

When you insert the rotary switches into the holes on the PC board, make sure that you do not stress the pins. If the switch is difficult to insert, check that the holes are large enough and

Table 2: Capacitor Codes

Value	IEC	EIA
0.22µF	220n	224
0.15µF	150n	154
0.1µF	100n	104
0.047µF	47n	473
.0027µF	2n7	272
.001µF	1n0	102
47pF	47p	47
39pF	39p	39
6.8pF	6p8	6.8

Table 3: EIA Trimpot Codes

Trimpot	Resistance	EIA Code
VR1	100Ω	101
VR2	100kΩ	104
VR3	10kΩ	103
VR5	5kΩ	502

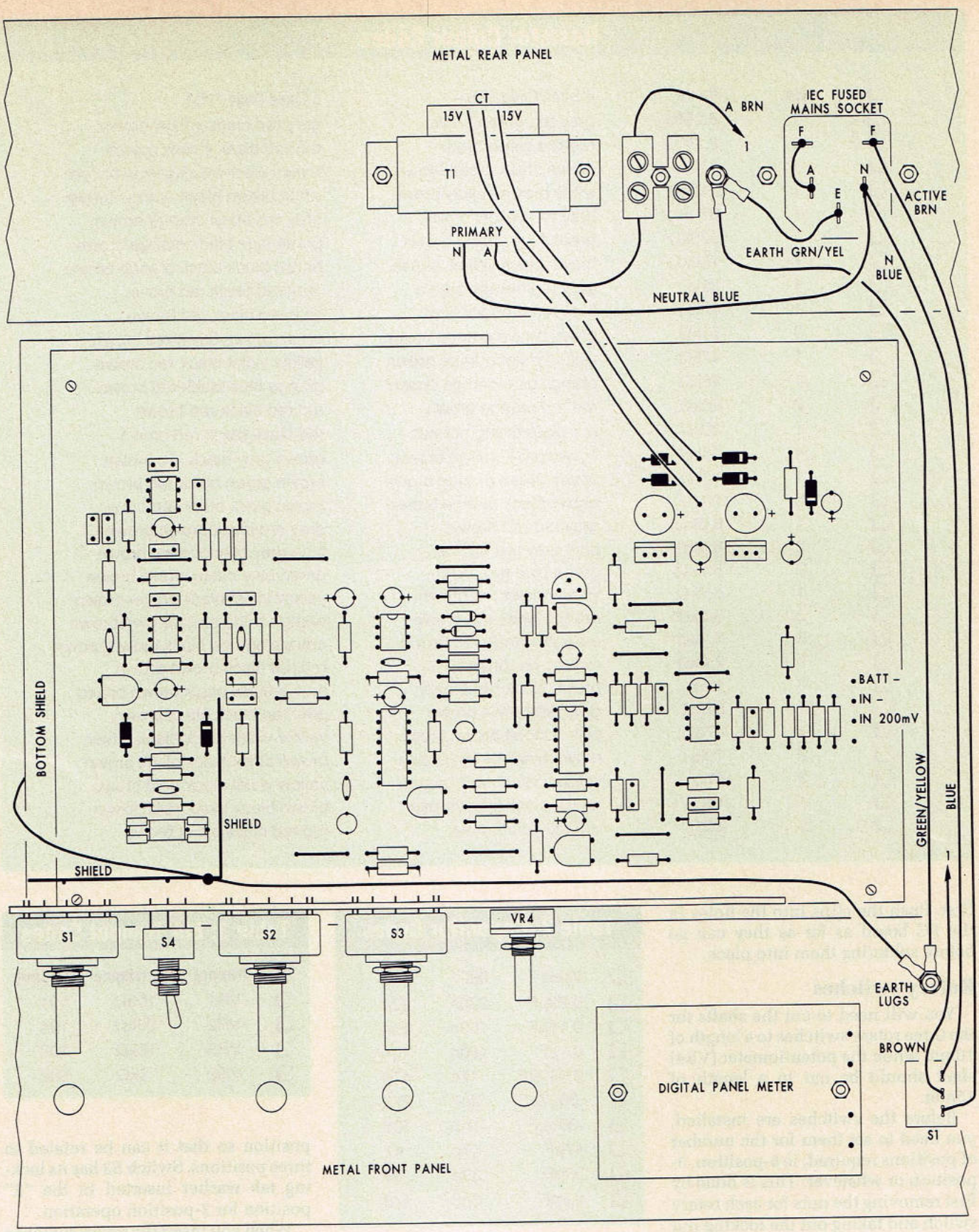


Fig.4: the wiring details for the AC Millivoltmeter. The various Earth connections are most important if minimum noise pickup is to be obtained. The front and rear panels must also be securely earthed to ensure electrical safety.

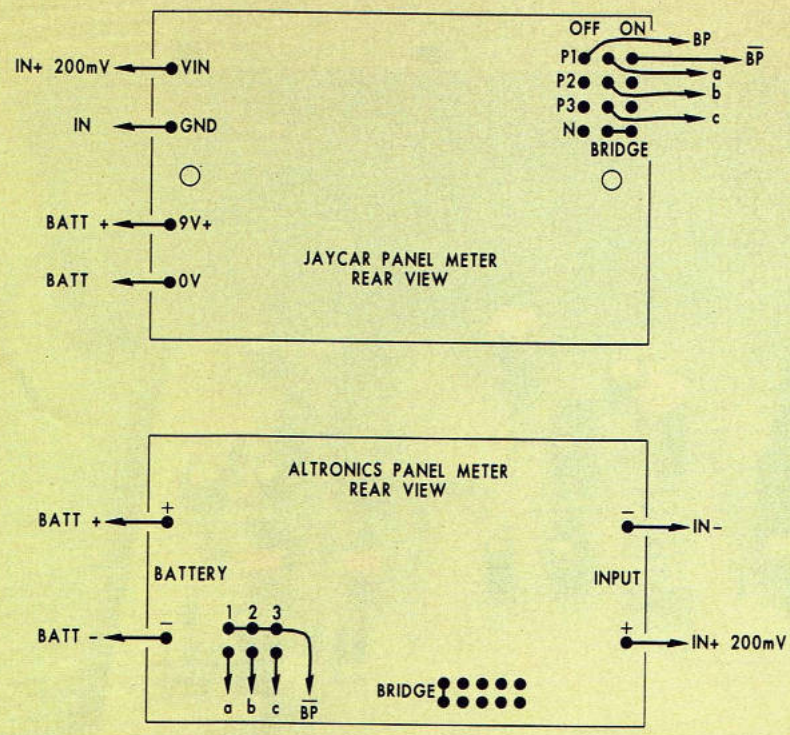


Fig.3: these diagrams show the connections to the two different LCD panel meters that can be used with the AC Millivoltmeter.

that the switch body is rotated so that the contact wiper pins are aligned correctly with the holes on the PC board.

The terminals of potentiometer VR4 are soldered to three PC stakes and these secure it in position. You make the installation more rigid by using a drop of super glue between its case and the PC board.

Switch S4 can be mounted in one of two ways. If you have a PC-mount version you can solder its terminals directly to the PC board. Otherwise, you will need to solder it to three PC stakes. Cut these down almost flush with the PC board so that the switch sits as low as possible.

Connecting the PC boards

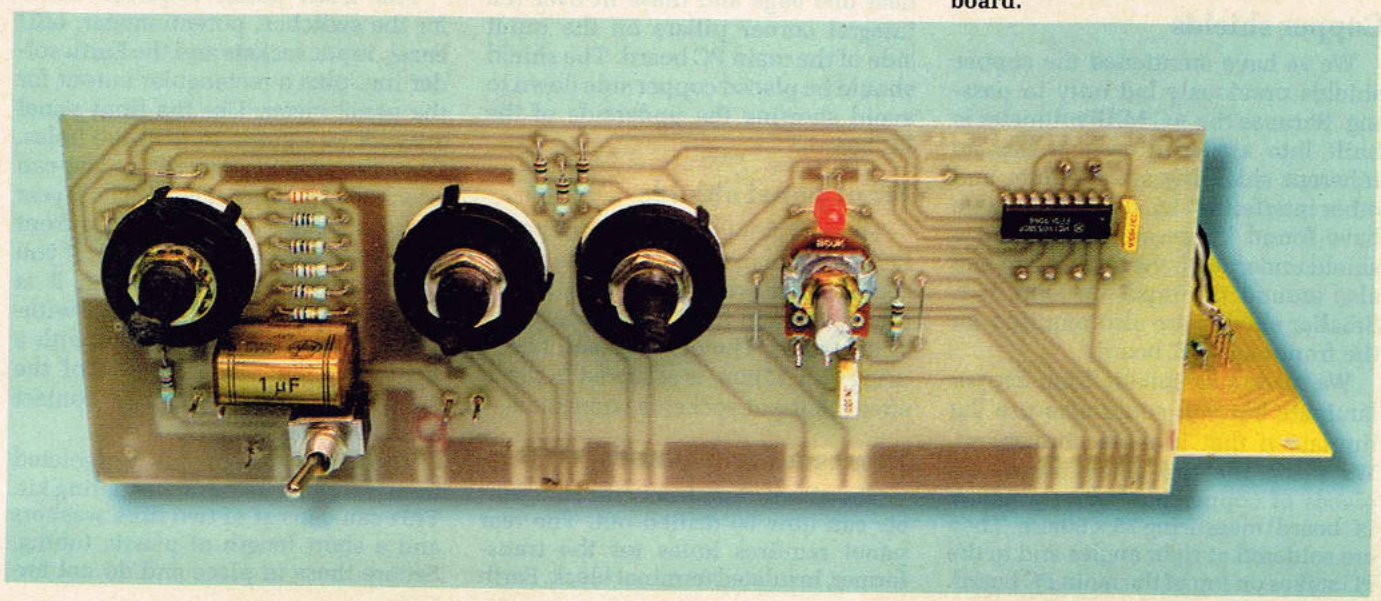
As mentioned above, the front panel PC board is soldered at right angles to the main PC board. To do this, place the main PC board in position in the base of the case. Check that none of the integral standoff pillars are preventing the PC board from sitting on the four corner pillars. The unused pillars can be cut down with a large drill to prevent them fouling the underside of the PC board.

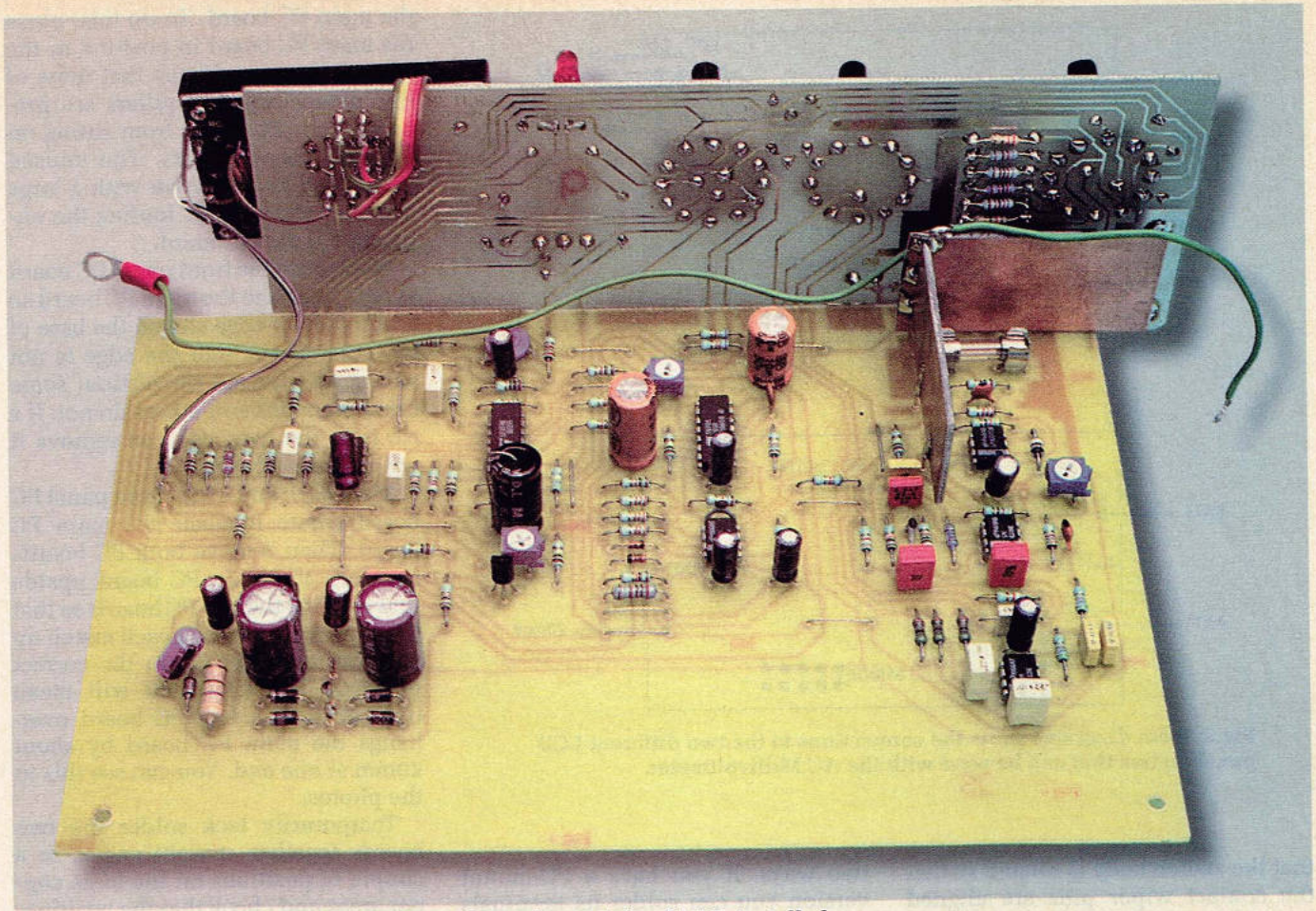
Now place the front panel PC board at right angles to the main PC board so that its lower edge sits on the base of the case. Check that the edge is not sitting on a raised rib section; some cases have ribs and others do not. If a rib is in the way, you can remove it with a sharp chisel.

Mark each end of the front panel PC board where it meets the main PC board. Then remove both PC boards and turn the main PC board upside down. Align the two PC boards so that the copper patterns for each match up and the markings are in the correct position. The alignment will mean that the front panel PC board overhangs the main PC board by about 20mm at one end. You can see this in the photos.

Temporarily tack solder the two boards together at right angles in a couple of positions on the large copper areas and check that the positioning is correct when placed in the case.

Below: this photo shows the front panel board before the shields are installed around the attenuator switch on the lefthand side. Note that some of the attenuator resistors are installed on the copper side of the front panel board.





The two boards are soldered together at right angles and the shields installed around IC1 before the whole assembly is installed in the case. Note the earth leads to the shield on the top of the main PC board and to the ground plane underneath this board.

Then solder the remaining connections. Make sure that all connections are soldered to ensure circuit continuity.

Copper shields

We've have mentioned the copper shields previously but only in passing. Because the AC Millivoltmeter is built into a plastic case, it has no inherent shielding against hum and other interfering signals. Therefore we have found it necessary to mount a shield underneath the main board and also around the input op amp, IC1. Smaller shields are also required for the front panel PC board.

We made our shields from copper laminate but you could also use flat tinplate if that is more convenient. We made the top shield from two pieces of copper laminate (ie, blank PC board) measuring 25 x 50mm. They are soldered at right angles and to the PC stakes on top of the main PC board.

The shield for the underside of the main PC board measures 80 x 60mm and is located directly under IC1 and fuse F1. It has two 8mm holes drilled near one edge and these fit over the integral corner pillars on the input side of the main PC board. The shield should be placed copper side down to avoid shorting the underside of the PC board.

Front panel shields

The two shields for the front panel PC board are mounted near the input socket, as shown in Fig.1. Only solder the side shield (30 x 15mm) in place at this stage. The other shield, measuring 65 x 15mm, is soldered in place after the input socket is connected.

Front and rear panels

The aluminium front and rear panels can now be drilled out. The rear panel requires holes for the transformer, insulated terminal block, Earth terminal and the cutout for the fused IEC mains socket. This cutout can be made by drilling a series of holes around the cutout border and removing the inside piece. The hole can then be filed to shape. Two holes are required for the mounting screws. Install all the hardware in place with screws and nuts.

The front panel requires holes for the switches, potentiometer, LED bezel, input sockets and the Earth solder lug, plus a rectangular cutout for the panel meter. Use the front panel artwork as a guide to drill the holes. Once the panel is drilled out you can attach the front panel label. The Jaycar panel meter is supplied with a front bezel which secures it in place. If you are using the Altronics meter, it is designed to be fitted in the panel without a bezel. It can be secured with a screw and nut on each side of the meter or by using a dab of contact adhesive.

The input sockets must be isolated from the panel using an insulating kit. This can consist of two fibre washers and a short length of plastic tubing. Secure these in place and do not for-

Parts List For AC Millivoltmeter

1 PC board, code 01510981, 212 x 142mm
1 PC board, code 01510982, 202 x 73mm
1 shield PC board, 80 x 60mm
2 shield PC boards, 25 x 50mm
1 shield PC board, 65 x 15mm
1 shield PC board, 30 x 15mm
1 front panel label, 249 x 76mm
1 plastic instrument case, 260 x 190 x 80mm
2 aluminium front and rear panels to suit case
1 3½-digit LCD panel meter (see text)
1 2855 30V centre-tapped mains transformer (T1)
1 IEC 240V fused panel-mount male socket
1 IEC 7.5A mains power lead
1 2-way insulated terminal block
1 SPST mains rocker switch with Neon indicator (S5)
1 PC-mount 2-pole 6-position rotary switch (S1)
1 PC-mount 1-pole 12-position rotary switch (S2)
1 PC-mount 3-pole 4-position rotary switch (S3)
1 PC-mount SPDT toggle switch (S4)
1 16mm 50kΩ linear (B) potentiometer
4 knobs to suit
2 insulated panel-mount BNC sockets
1 5mm LED bezel
5 M3 x 12mm screws
4 M3 star washers
5 M3 nuts
2 M4 x 12mm screws
2 M4 star washers
2 M4 nuts
4 self-tapping screws
4 crimp or solder lugs
2 2AG fuse clips
1 2AG 1A fast-blow fuse (F2)
1 2AG 630mA fast-blow fuse (F1)
1 500mm length of brown 240VAC 7.5A mains wire
1 250mm length of blue 240VAC 7.5A mains wire
1 250mm length of green/yellow 240VAC 7.5A mains wire
1 250mm length of green hookup wire
1 400mm length of 0.8mm diameter tinned copper wire
1 200mm length of 5-way rainbow cable
31 PC stakes

Semiconductors
1 OP27, LM627 low noise op amp (IC1)
3 LM833 dual op amps (IC2, IC3, IC5)
1 SSM2018 Analog Devices voltage controlled amplifier (IC4)
1 LF347, TL074 quad op amp (IC6)
1 TL072 dual op amp (IC7)
1 4053 3-pole 2-position CMOS analog switch (IC8)
1 LM336-2.5 2.490V reference diode (REF1)
1 7815 15V 3-terminal regulator (REG1)
1 7915 -15V 3-terminal regulator (REG2)
2 1N4936 1A fast diodes (D1,D2)
2 1N4148, 1N914 signal diodes (D3,D4)
4 1N4004 1A rectifier diodes (D5-D8)
1 9.1V 1W zener diode (ZD1)
1 5mm red LED (LED1)

Capacitors
2 1000µF 25VW PC electrolytic
1 100µF 16VW PC electrolytic
1 22µF non-polarised PC electrolytic
6 10µF 35VW PC electrolytic
3 10µF 16VW PC electrolytic
1 10µF non-polarised PC electrolytic
1 6.8µF non-polarised PC electrolytic
1 1µF 200VDC metallised polyester (19mm max height)
2 0.22µF MKT polyester
2 0.15µF MKT polyester
5 0.1µF MKT polyester
1 .047µF MKT polyester
1 .0027µF MKT polyester
3 .001µF MKT polyester
1 47pF ceramic
2 39pF ceramic
2 6.8pF ceramic

Resistors (0.25W 1%)

1 8.2MΩ	16 10kΩ
1 2.2MΩ	1 8.2kΩ
1 1MΩ	2 6.8kΩ
1 910kΩ	2 5.6kΩ
1 820kΩ	1 4.7kΩ
1 560kΩ	2 3.9kΩ
7 100kΩ	5 3.3kΩ
1 82kΩ	1 2.2kΩ
1 62kΩ	3 1kΩ
3 51kΩ	1 820Ω
1 47kΩ	1 470Ω 0.5W
1 36kΩ	2 100Ω
2 22kΩ	3 47Ω
1 20kΩ	1 10Ω
4 18kΩ	2 2.2Ω
1 15kΩ	

Trimpots
1 100kΩ horizontal trimpot (VR2)
1 10kΩ horizontal trimpot (VR3)
1 5kΩ horizontal trimpot (VR5)
1 100Ω horizontal trimpot (VR1)

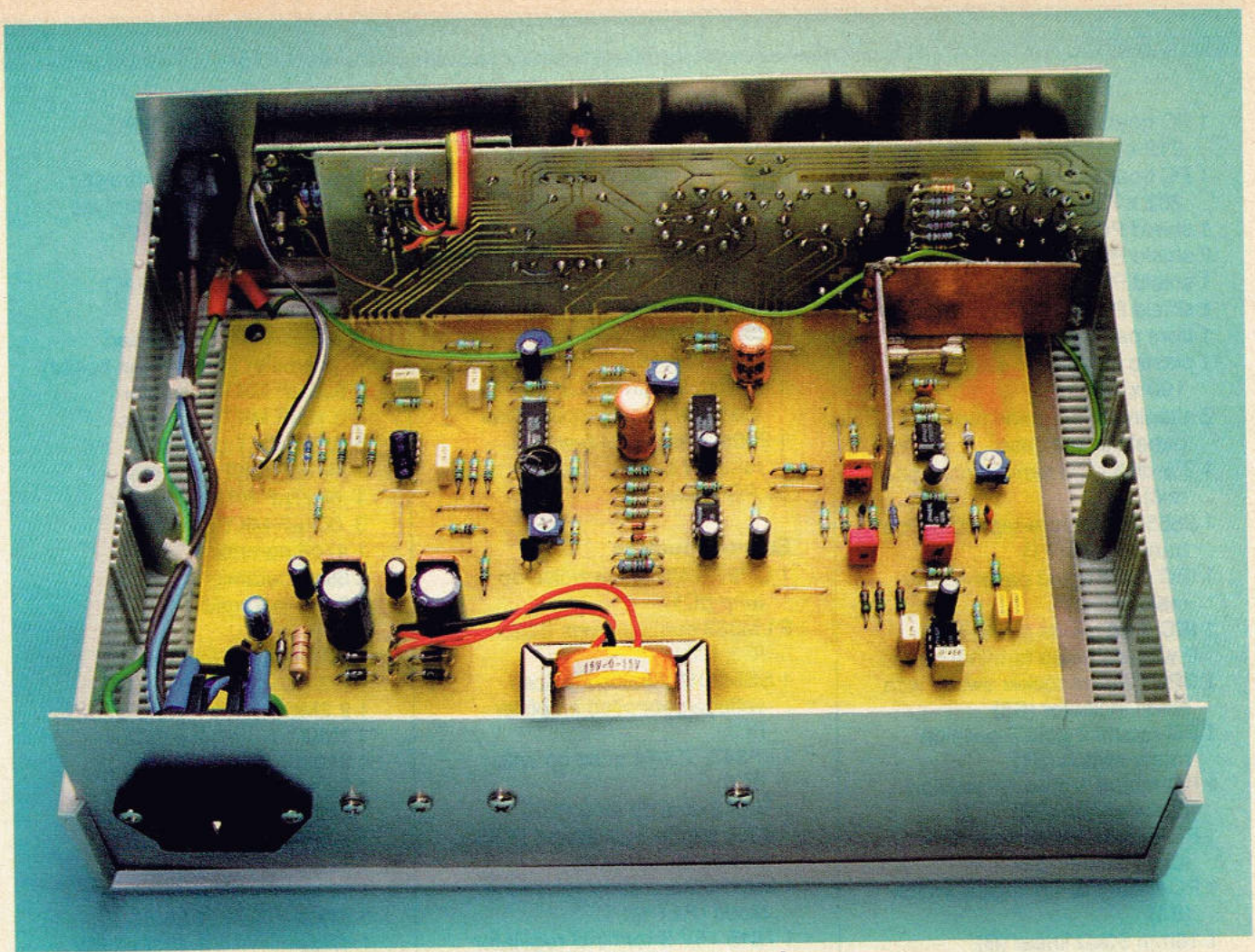
Miscellaneous
Heatshrink tubing, cable ties, solder, etc.

get to place the solder lugs beneath the retaining nuts. Make sure that the nuts are tight otherwise the sockets will inevitably twist and break their connections when cables are being connected or disconnected.

Interconnecting wiring

Rainbow cable should be attached to the panel meter for the decimal point, BP outputs, battery supply and the IN + and IN- connections. These connection details are shown in Fig.4. Note that the Jaycar meter will require a wire bridge to select the automatic polarity indicator (the minus sign). Also the Jaycar meter has both backplane signals (labelled on and off) which must be wired. The Altronics meter does not require a bridge for the minus sign or the backplane signal to turn off a decimal point.

Place the front panel over the front panel PC board and wire the input socket and oscilloscope socket to the PC pins on the board using short lengths of tinned copper wire. The



The rear panel of the AC Millivoltmeter is bare except for the IEC mains socket. Use cable ties to keep the mains wiring neat and tidy and be sure to insulate the mains switch and IEC socket connections using heatshrink tubing.

65mm long shield can now be attached by soldering it to the side shield and PC stakes.

Fig.3 shows the details of all the remaining wiring. The mains wires must be 240VAC-rated. Heatshrink sleeving should be placed over the terminals of the IEC socket and mains switch (S1). The Earth wires must be the standard green/yellow striped wire and are terminated to solder or crimp lugs. These lugs are secured to the panels with a screw, nut and star washers. Tie the mains wires together with cable ties at the switch and the IEC socket. A tie should also be placed around the wires entering the terminal block.

Testing

When you have completed construction and wiring, check your work carefully for mistakes. In particular, be sure that the ICs are oriented correctly and that each regulator is in its correct position and orientation. Now apply power and check that the Neon glows in the power switch and that the display is on.

Check voltages on the circuit using a multimeter. Clip the negative lead of your multimeter to the metal tab of REG1 and measure the supply pins for each IC. IC1 should have +15V at pin 7 and -15V at pin 4. IC2, IC3, IC5 and IC7 should have +15V at pin 8 and -15V at pin 4. IC4 should have +15V at pin 2 and -15V at pin 16. IC6 should have +15V at pin 4 and -15V at pin 11. Check that the voltage at the cathode of ZD1 is about 9V.

Now check that the display is operating correctly. Set the dB/V switch to read Volts and rotate the attenuator to check that the decimal points change. The righthand decimal point should be on when the dB/V switch is set to dB. Check your wiring if this is not correct.

Calibration

Set the attenuator switch to 200V and the dB/V switch to Volts. Adjust trimpot VR5 so that display shows 00.0V. This is the offset adjustment to zero the display.

You will require an AC signal source to calibrate the millivoltmeter. Apply a 1V RMS sinewave to the input. This can initially be checked for level using a multimeter set to read AC volts. Set the attenuator to 2V and adjust VR1 so that the panel meter shows 1.000V. If you have an oscilloscope you can check that the waveform at the CRO socket is about 280mV p-p.

If your AC signal source has other output ranges you can check that the Millivoltmeter reads accurately at other attenuator settings.

The dB linearity needs to be adjusted so that these readings are accurate. It can be done with a 1V RMS

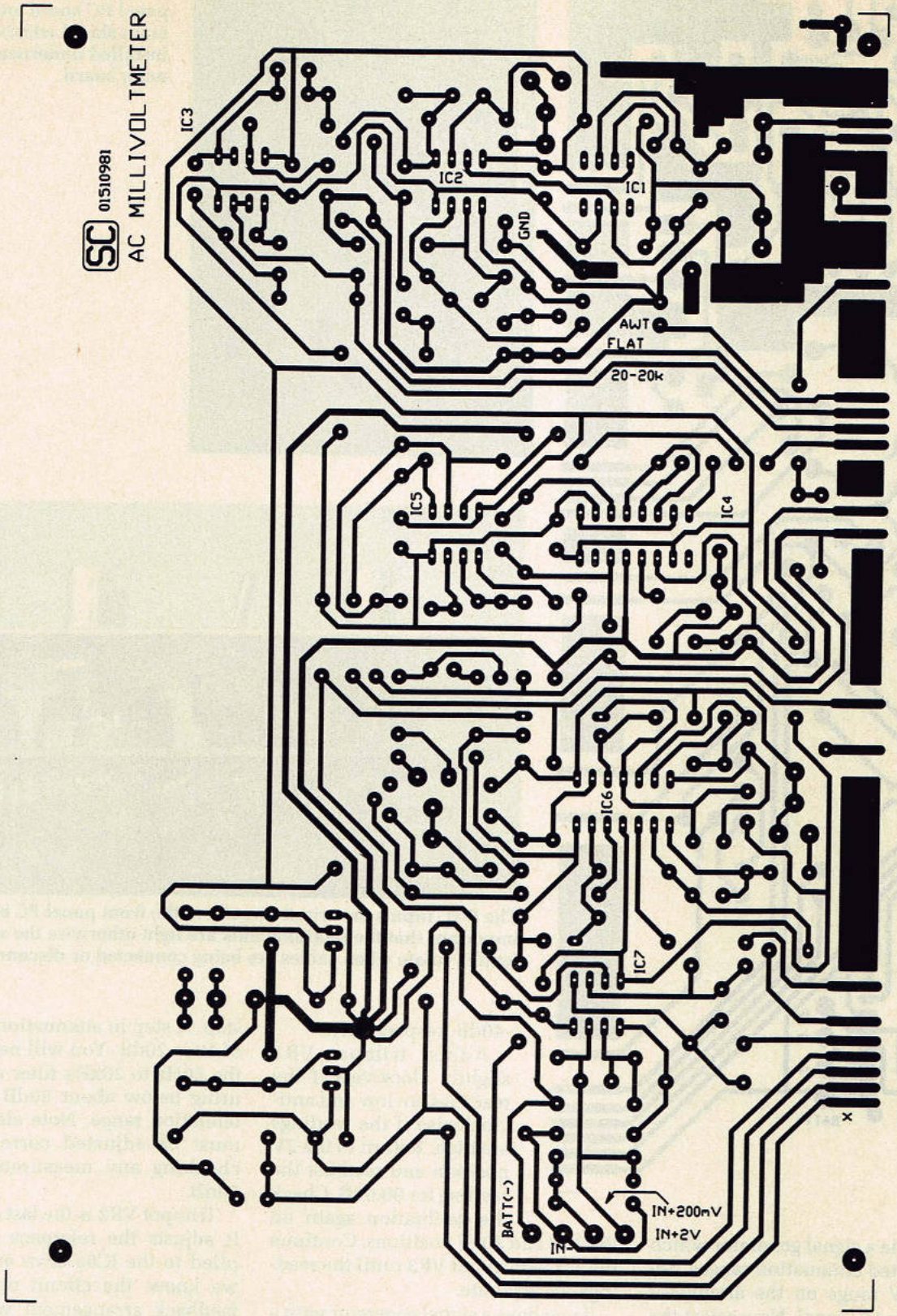
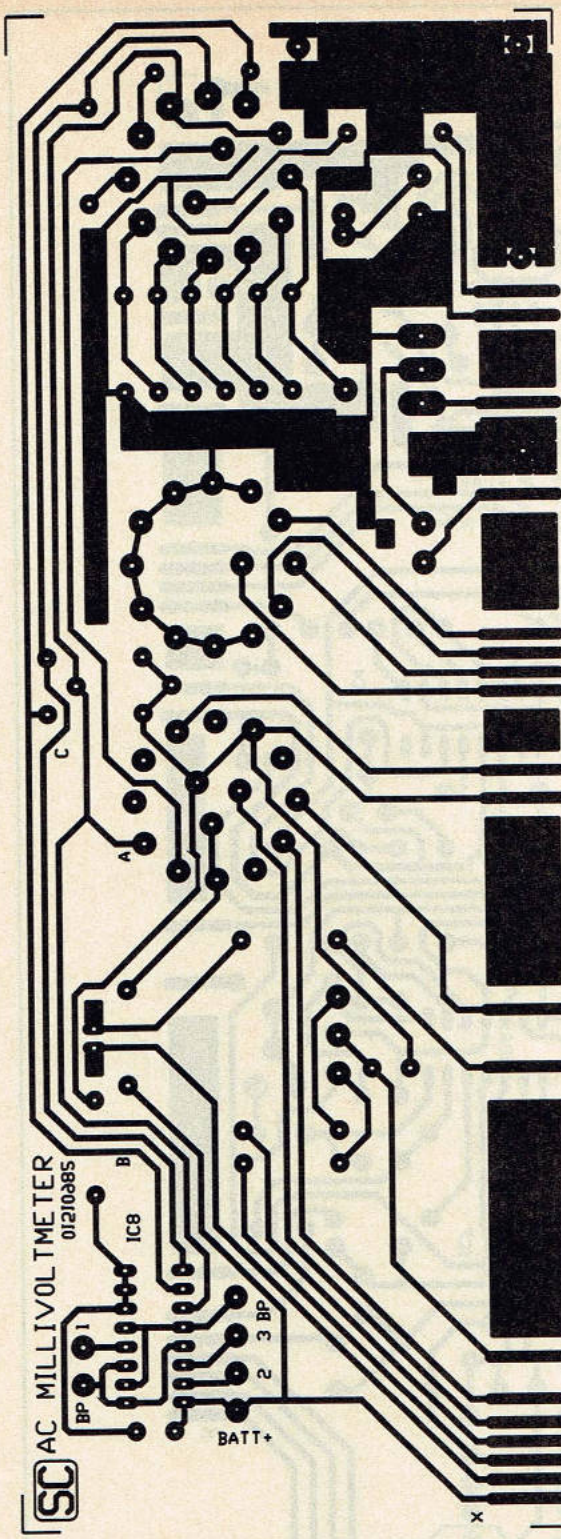


Fig.5: this is the actual size artwork for the main PC board. Check the board carefully for etching defects before installing any of the parts.



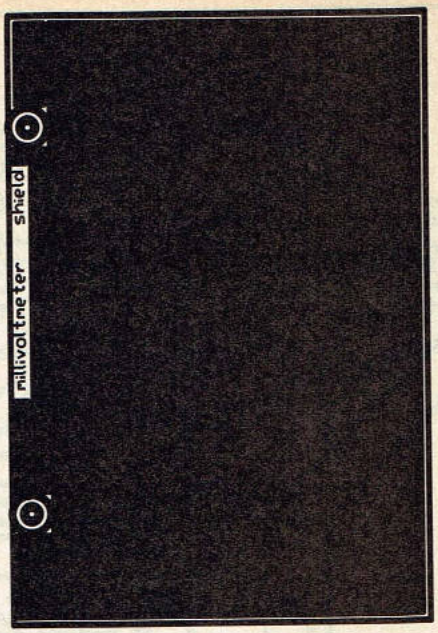
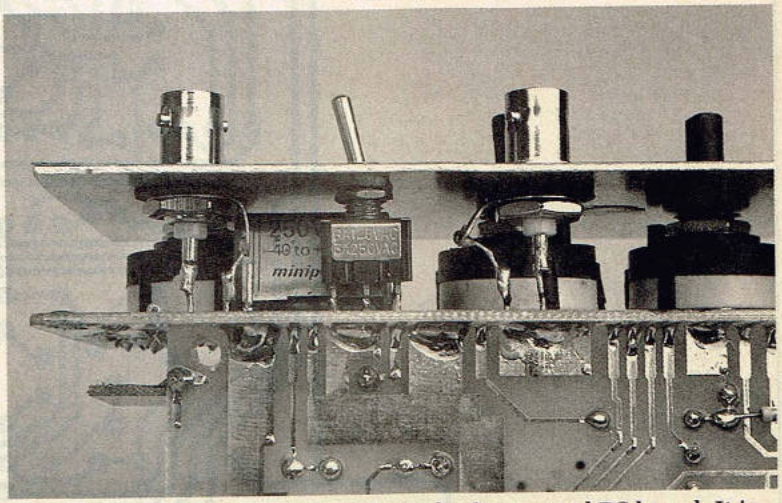


Fig.6: these are the actual size artworks for the front panel PC board and the main shield which is installed underneath the main board.



The BNC inputs are wired directly to the front panel PC board. It is important that the retaining nuts are tight otherwise the sockets will tend to rotate when cables are being connected or disconnected.

source or via a signal generator which has calibrated attenuation ranges. Select the 2V range on the attenuator and apply a 1V signal. Now select the dB measurement and adjust the set level pot so that the reading is 00.0dB. Now move the attenuator to the 20V position and then the 200V position. The readings should be -20dB and -40dB, respectively.

Adjust trimpot VR3 slightly clockwise if the readings are low and anti-clockwise if the readings are high. Return to the 2V position and readjust the reading for 00.0dB. Check the calibration again on the 20V and 200V positions. Continue the adjustment on VR3 until the readings are accurate.

If you have a signal generator with a calibrated attenuator, then you can check the calibration by successively attenuating the signal and checking that the readings are correct. Note that an attenuation factor of 3.16 is a 10dB step. A step in attenuation by a factor of 10 is 20dB. You will need to select the 20Hz to 20kHz filter when measuring below about 50dB on any attenuation range. Note also that VR2 must be adjusted correctly before checking any measurement below 50dB.

Trimpot VR2 is the last adjustment. It adjusts the reference voltage applied to the IC6a error amplifier. As we know, the circuit operates in a feedback arrangement whereby the voltage controlled amplifier is controlled with the error amplifier so that the signal output after rectifying and filtering equals the reference voltage level.

Now if we short the input to the Millivoltmeter, the voltage controlled amplifier must provide a large amount of gain so that the noise within the Millivoltmeter circuitry equals the reference. If the reference voltage is too high, then the VCA cannot provide enough gain to match it with the noise signal and so we lose control of the feedback circuit.

The way to solve this lack of control is to adjust the reference voltage so that the noise produced with the VCA set for maximum gain can match the reference.

VR2 adjusts this reference and is adjusted with the input shorted and the attenuator set to 2mV. The filter must also be set to "A" weighting. Now rotate VR2 fully clockwise. Slowly rotate VR2 anticlockwise and watch the reading increase in value. Continue adjustment until the display suddenly increases rapidly and locks up a -1 on the display. Switch off the power and rotate VR2 slightly more clockwise. Switch on power again and check that the reading sits at a stable value. It should be about -66.0dB to -68.0dB. If the reading stays stable, then leave VR2 as set. If the display continues to go to -1, then you will need to readjust VR2.

Check the calibration of the dB ranges again before completing the setting up procedure.

Making measurements

When you are measuring audio equipment with this AC Millivoltmeter there are a few points to note. Firstly, frequency response checks must be made with the filters set to Flat. Otherwise you could be measuring the frequency response of the filters rather than the equipment under test.

Signal-to-noise ratio is always measured with respect to a reference signal. When testing amplifiers, the reference level is usually full power output (ie, just before onset of clipping) or 1W. So typically you will adjust the "dB Set Level" control to produce a reading of 00.0 at full power. For line level equipment it is usual to specify the reference at either 1V or 0.775V which is equivalent to 1mW into 600Ω.

When measuring the residual noise from a piece of equipment such as an amplifier, it is important to apply a loading resistor to its input. This simulates the source resistance of the normal audio signal generator which may be CD player, for example. A 1kΩ resistor is normal for most audio equipment.

After the reference level has been set for a reading of 00.0dB, the applied signal is removed, the input loading resistor is connected and the AC Millivoltmeter's attenuator is switched down to the 2mV position. It is necessary to count the number of steps that the attenuator is moved from the initial position down to the 2mV position. To obtain the noise figure, add 20dB per step to the reading on the meter.

Finally, the earthing can make a difference to the reading. Check that you do not have an earth loop whereby the signal is connected to ground at two different points. You can have the Millivoltmeter grounded or floating, to either ground the signal or remove the ground loop if the equipment under test is also grounded. Note also that the oscilloscope provides the ground to earth. If you do not use an oscilloscope, you can simulate its earthing by connecting the earth of the scope outlet to the mains earth on the front panel. SC

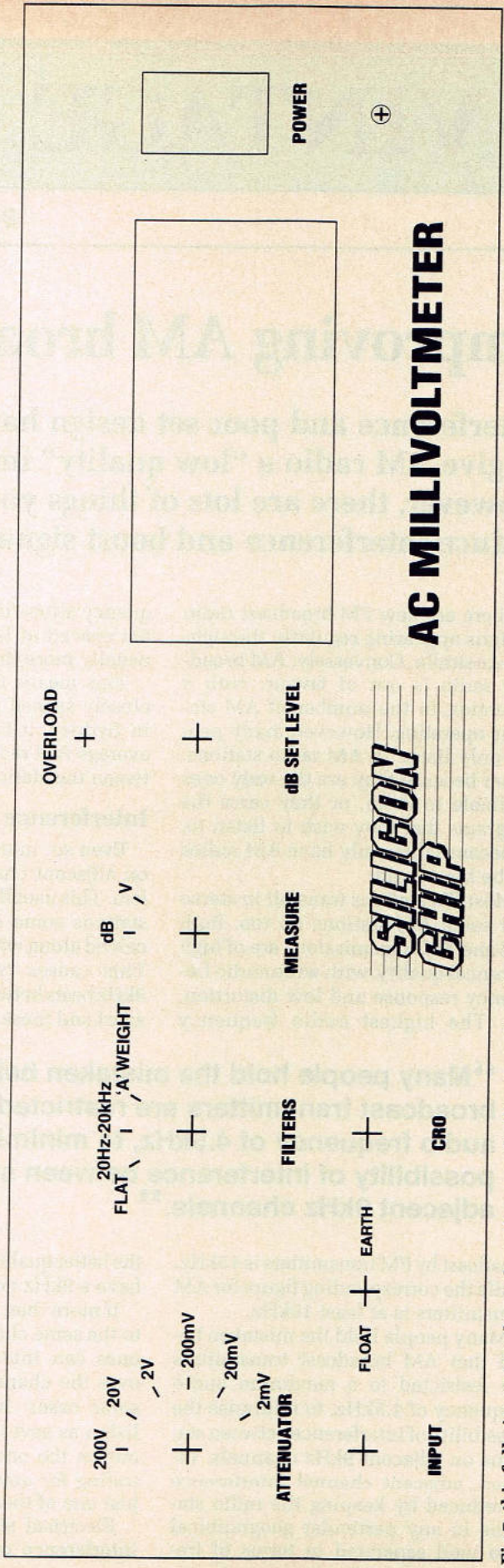


Fig.7: this full-size artwork can be using as a drilling template for the front panel.

VINTAGE RADIO

By RODNEY CHAMPNESS, VK3UG

Improving AM broadcast reception; Pt.1

Interference and poor set design have combined to give AM radio a "low quality" image. However, there are lots of things you can do to reduce interference and boost signal quality.

There are new FM broadcast radio stations appearing regularly throughout Australia. Conversely, AM broadcast radio is out of favour, with a reduction in the number of AM stations operating. However, many people only listen to AM radio stations, either because they are the only ones available to them, or they carry the programs that they wish to listen to, or because they only have AM radios in the household.

Most FM stations transmit in stereo and some AM stations do too. Both AM and FM transmissions are of high technical quality, with wide audio frequency response and low distortion, etc. The highest audio frequency broadcast by FM transmitters is 15kHz, while the corresponding figure for AM transmitters is at least 10kHz.

Many people hold the mistaken belief that AM broadcast transmitters are restricted to a maximum audio frequency of 4.5kHz, to minimise the possibility of interference between stations on adjacent 9kHz channels. Instead, adjacent channel interference is reduced by keeping the radio stations in any particular geographical area well separated in terms of frequency allocation. Typically, stations are spaced at least 45kHz apart and usually more than 100kHz apart.

This means that even in the most closely spaced parts of the spectrum in Sydney, it is not difficult for the average AM radio to discriminate between the stations.

Interference

Even so, interference from stations on adjacent channels can be a problem. This usually occurs at night when stations some distance away are received along with the "local" stations. This causes "monkey chatter" and 9kHz beats between stations only 9kHz apart and these beats will be heard on the better quality receivers if they don't have a 9kHz notch filter.

"Many people hold the mistaken belief that AM broadcast transmitters are restricted to a maximum audio frequency of 4.5kHz, to minimise the possibility of interference between stations on adjacent 9kHz channels."

If more than one station is assigned to the same channel, the more distant ones can interfere too, even taking over the channel for a short time in some cases. It can be intriguing to listen as several stations fade in and out on the one channel but it's frustrating for anyone trying to listen to just one of those stations.

Electrical storms also often cause interference to AM radio reception, particularly in summer and towards the equator. Unfortunately, there are no easy methods that can be used to eliminate this type of interference, although noise limiters can provide some relief.

In summary, AM radio suffers from various interference problems and this is why it has lost popularity, particularly for night-time reception. However, some listeners like to log as many distant AM broadcast stations as possible (DX) and these articles, although not specifically aimed at such listeners, will provide ideas that will assist them too.

AM tuner quality

In most developed countries, there has been a definite swing to FM broadcasting and AM has been relegated to the position of the poor relation. If a check is made of the specifications of an AM/FM receiver/tuner, it will be noticed that the FM section is usually extremely good in all areas. Conversely, the specifications of the AM section will be markedly inferior to those for the FM section.

But that's not all – the AM section will generally be inferior to the sets produced in Australia from the late 1930s to the 1960s. These include both valved sets and the later Australian-made transistor receivers. These sets were very sensitive and capable of receiving stations hundreds of kilometres away in daylight. And some were designed to have quite reasonable fidelity as well.

In short, the sensitivity, bandwidth, AGC characteristics, detector distortion, etc, of the average imported set is almost sure to be inferior to the best of those old receivers. The average AM receiver is really quite a poor performer these days and its inability to reject interference has given AM

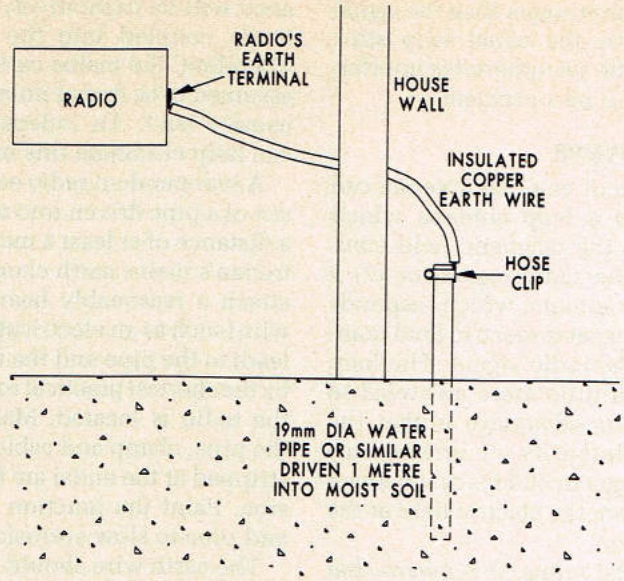

RADIO
RADIO'S EARTH TERMINAL
HOUSE WALL
INSULATED COPPER EARTH WIRE
HOSE CLIP
19mm DIA WATER PIPE OR SIMILAR DRIVEN 1 METRE INTO MOIST SOIL

Fig.1: AM reception can often be improved by running a separate earth lead from the radio's earth terminal (if it has one) to a metal stake driven into the ground. Note that a .001µF - .01µF capacitor may need to be inseted in series with the lead at the set's earth terminal – see text.

broadcast radio a reputation for poor quality – which is really not true.

Australia no longer has a consumer broadcast receiver manufacturing industry, so most of our domestic receivers are imported from Asia, Europe or North America. Because of their population densities, they can afford to have many FM broadcast stations to serve their needs, as only relatively short distances need to be covered. The same goes for AM broadcasts.

In short, the emphasis in these countries is on FM and in any case, the distance to the nearest FM or AM stations will be quite small. For this reason, the AM sections are designed for urban use only and have low RF/IF gain, indifferent IF selectivity and usually poor overload characteristics. These sets also have poor RF selectivity (with no RF stage) and an autodyne oscillator/converter which produces significant oscillator harmonics. This in turn can result in considerable breakthrough of shortwave stations into the broadcast band at times.

In Australia, the distance between AM broadcast transmitters is generally greater due to our low population density. As a result, these imported sets perform poorly in regional areas and on city margins. The only thing going for them is that they are cheap compared to the good AM transistor radios that were produced in Australia.

There are other reasons why people listen mainly to local stations, apart from the fact that the receivers now available are poor distance performers. One of the bugbears of AM radio reception is man-made interference. Electrical interference of various sorts is predominantly an amplitude variable phenomena which is readily reproduced by AM receivers. Properly designed FM receivers respond to frequency variations and reject amplitude variations. As a result, they reject most forms of interference, whether natural or man-made.

Interference reduction

Electrical interference from power lines and various electrical/electronic devices can be minimised or even eliminated by employing one or more of the techniques described in this and the following article. AM reception can be poor due to the use of mediocre AM receivers, ineffective aerial/antenna systems and the high level of interference in some locations. However, many of the problems can be resolved or at least minimised so that good AM radio reception can be achieved.

Interference does not have to be as strong as the station being monitored to be annoying. Many of the broadcast stations that listeners may wish to receive are not all that strong (I listen in daylight to 5CK which is 750km away from Benalla) and hence even weak interference is annoying.

Part of the problem is that we belong to the "portable" society, where everything has to be easily transportable. The concept of "portability" is equally applied to radios and so radios designed for the domestic market are generally not provided with an external antenna connection. And if they were provided with one, the design inadequacies would soon become obvious.

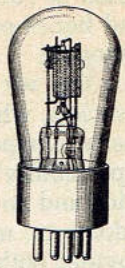
The most convenient place to put the radio is on the refrigerator, a kitchen bench or on a workshop bench. Unfortunately, these are usually the worst locations for interference in our homes. The "quietest" place is out in the backyard, away from all power sources, cars in the street, lawn mowers, etc. A few really electrically quiet locations are at the beach, in a row boat at sea or in the outback away from it all.

Modern homes are often worse than older dwellings for radio reception. For example, they may have metallised insulation paper in the walls, while the floor and sometimes the ceiling (especially in units) can be a reinforced concrete slab. This forms a very effective radio frequency (RF) shield, which means radio signals have a hard job getting into the dwelling, except through breaks in the shield and via the electrical power mains. For this reason, placing the radio near a window or near power wiring often improves reception.

Interference sources that affect radios within this RF shield include computers, fluorescent lights (particularly the electronic types), food mixers, TV receivers, light dimmers, shavers, electric drills and touch lamps, etc. The interference generated by these sources is easily picked up directly by the radio. Some of it also travels along the mains wiring in the home and then radiates into the radio. It can also travel via the mains and interfere with the radio reception in neighbouring houses or units.

Another source of interference is from high-voltage power lines. The interference can be due directly to problems on the mains (eg, arcing in wet weather) or generated by an electrical appliance.

Looking for an old valve?



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Because of the effects described above and because they don't know how to overcome interference problems, most listeners give up and listen only to the local stations. However, there are a number of ways that the interference can be dealt with. The source of the interference can be suppressed or ways can be found to minimise the effect of the interference and increase the radio signal into the bargain.

The easiest approach (apart from moving the receiver) is to improve the signal so that it overrides any interference or set noise. One approach is to site an antenna (preferably a noise-reducing type) in a relatively noise-free environment and where there is good signal strength. This will usually involve using an outside antenna in the backyard, at least five metres away from any building or electrical catenary wiring. The signal is then fed to the radio receiver via a cable that does not pick up any signals or any interference as it passes through what may be an electrically noisy area.

Either a coaxial cable or some form of twin cable can be used. The signal to the set via the external antenna must be much stronger than the signal picked up by the usual loop stick antenna in the set, otherwise interference may still be a problem.

Antenna types

Two types of external antenna can be used: (1) a loop antenna which responds to the magnetic field component of the radio signal; or (2) a "long" wire antenna which responds to the electrostatic/electric field component of the radio signal. The loop antenna is a little more awkward to install but its advantage is that the near field intensity of interference from the magnetic field is much lower than that from the electric field at the same location.

In practical terms, this means that the interference level picked up by a loop antenna is much lower than when using a "long" wire antenna – particularly if the antenna cannot be located in a noise-free area.

Portable transistor receivers use a loop antenna so they will do a better job of receiving signals in a noisy environment compared to sets using a wire antenna run around the skirting board. However, the loop in the transistor receiver cannot eliminate all interference or intercept radio signals if they are almost non-existent.

A good earth

It is also very important to have a good earth system, to improve the strength of radio signals and to minimise interference. This is more important with the long wire antennas, although some loop antennas will also benefit from an earth system.

It is well known that the earth wire of a 3-pin power socket goes to an earth stake via the switchboard. This earth lead may be up to 30 metres long, or more. However, AC mains sets which have a 3-core lead and an earthed chassis do not seem to generally benefit from having an additional earth fitted when an external antenna is used.

In some cases, however, a noticeable improvement in reception quality can be obtained by installing an independent earth system as close as practical to the radio (assuming that the radio has a separate earth terminal). The reason for this is that the mains earth lead is encapsulated with other mains leads and these may have interference on them. This interference will be capacitively and inductively coupled into the earth lead. Therefore, the mains earth cannot be assumed to be free of interference and usually isn't. An independent earth can help eliminate this interference.

A independent radio earth can consist of a pipe driven into moist soil for a distance of at least a metre. An electrician's mains earth clamp is used to attach a reasonably heavy insulated wire (such as an electrical mains earth lead) to the pipe and the wire is taken by the shortest practical route to where the radio is located. Make sure that the pipe, clamp and cable (where it is stripped at the ends) are free of corrosion. Paint the junction of the cable and pipe to slow corrosion effects.

The earth wire should be insulated over its entire length (except at the ends), so that it does not touch other metallic objects; eg, a metallic insulation sheet in the house wall. If it touches these sheets, interference may be produced due to the minute voltage differences between the sheet and the wire.

For best performance, the radio should be located near an outside wall so that the earth lead can be kept as short as possible. The longer the earth lead, the less effective it becomes at reducing interference.

To eliminate low-frequency earth currents through the set, you can insert a capacitor of between .001µF and .01µF between this lead and the radio's earth terminal. Fig.1 shows how the earth is arranged (capacitor not shown). In my case, I have a radio earth in my workshop which almost eliminates fluorescent light noise. Another one in the kitchen reduces a myriad of electrical noises that had previously marred reception.

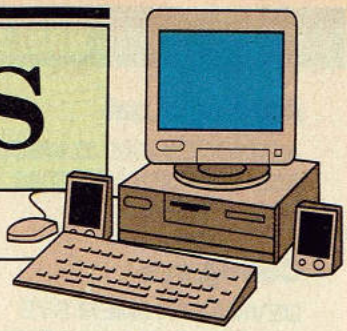
Next month

A variety of loop and long-wire antennas have been developed over the years and these will be described next month. Some are conventional while others are noise/interference reducing types.

One device – the "Radio Reception Booster" (a tuned inductive coupler) – can be used with any of the described antennas and markedly improves the performance of sets using loop-stick antennas. No modifications are required to sets that have no external antenna/earth terminals. SC

COMPUTER BITS

BY GREG SWAIN



Windows 98: how to clean install the upgrade version

You don't have to install the Windows 98 upgrade over the top of the existing operating system. Here's how to get rid of all those redundant files and do a clean install.

I have a public confession to make. I was one of the first people to buy Windows 98. No, I didn't line up at midnight outside a Harvey Norman store – I wasn't quite that desperate to try Bill's latest and greatest – but I was on the phone to a software retailer the very next morning.

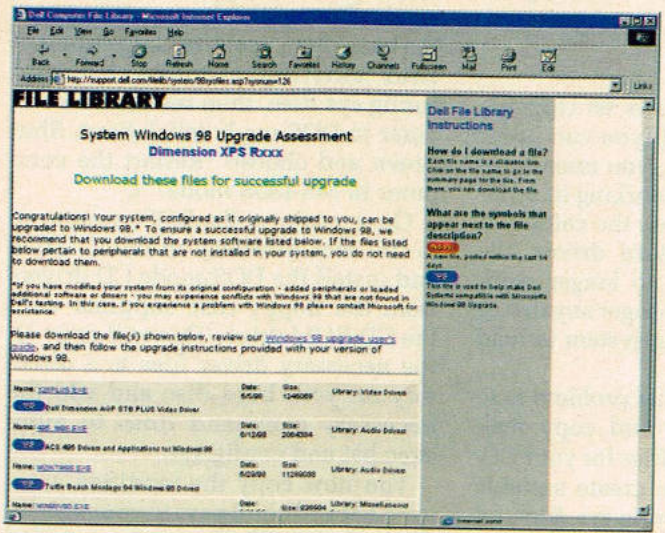
My aim was to update my computer – a dual-boot Windows 95/Windows 3.11 system. The dual-boot exercise had long since outlived its usefulness and I wanted to reclaim as much hard disc space as I could by getting rid of the now obsolete Windows 3.11. In addition, I could gain extra drive space by running Win98's FAT32 file system, something that wasn't available on my old A version of Windows 95.

Windows 98 also promised faster performance, a better interface, improved stability and a number of useful disc maintenance utilities that weren't included in Win95. It also offers web integration and even includes FrontPage Express, an easy-to-use HTML editing program that lets you create your own web pages.

As well as Windows 98, I also ordered a copy of Norton Uninstall. An uninstall package is virtually a "must-have" item, particularly if you regularly install new software. Norton Uninstall, for example, can completely track a new installation. It then gives you the option of uninstalling the new software and undoing any system changes (eg, to the registry) if you strike compatibility problems with the new program.

You can only do this for one program at a time, however. Once you've finally instructed Norton Uninstall to accept an installation or you tell it to track a new installation, there's no going back on changes to system files.

OK, so I've allowed myself to digress and having committed that sin, I'll digress further. The system that I wanted to upgrade used a Pentium 133 processor, two hard disc drives (1.3Mb & 1.6Gb) and 64Mb of RAM. The machine is a few years old now and I wanted to boost its performance without spending too much money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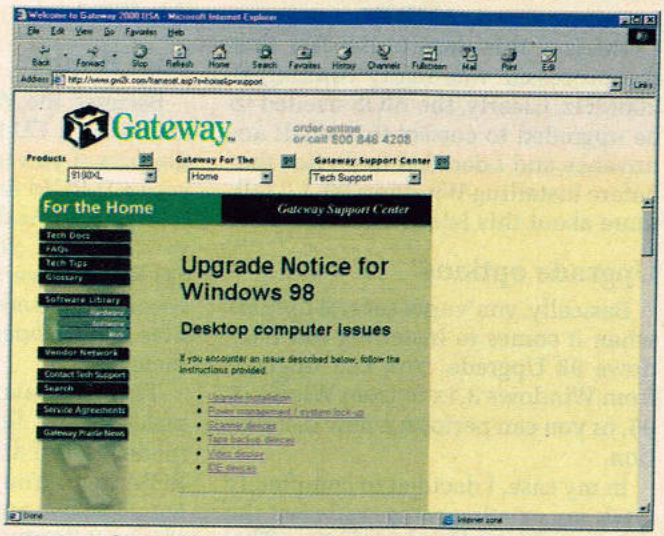
Dell File Library Instructions



If you have a Dell or Gateway computer, check the relevant company's web site (www.dell.com.au or www.gw2k.com.au) for Windows 98 upgrade advice on your specific model.

Boot Floppy System Files

Autoexec.bat

```
A:\MSCDEX.EXE /D:MSCD001 /L:R /M:8 /V
A:\SMARTDRV.EXE 2048 128
PROMPT $p$g
```

Config.sys

```
DEVICE=A:\HIMEM.SYS
DEVICE=A:\EMM386.EXE NOEMS
DOS=HIGH,UMB
LASTDRIVE=Z
DEVICE=A:\SBIDE.SYS /D:MSCD001 /P:170,15 /V
```

Fig.1: these are the autoexec.bat and config.sys files used on the boot floppy for my machine. The lines in italic type load the drivers for the CD-ROM drive. Check that the boot floppy works correctly and provides access to the CD-ROM drive before reformatting your hard disc drive.

(well, actually I didn't want to spend any money).

Doin' a deal

To cut a long story short, I happened to have a spare Pentium motherboard while a mate had a spare 200MHz AMD K6 chip in his possession. Maaaaate! Yep, we did a deal – my spare motherboard plus a couple of other goodies for the K6. When I installed the K6 on the motherboard in my machine and reset the jumpers so that it ran at 200MHz, I was pleasantly surprised at the difference it made. I didn't make any measurements but the difference between a 200MHz K6 chip and a Pentium 133MHz processor is considerable.

There was just one problem, if you could really call it that. During bootup, the system BIOS insisted that the new processor was an AMD K5 running at 133MHz – this despite the fact that the processor was really running at 200MHz. Clearly, the BIOS needed to be upgraded to correct this small annoyance and I decided to do just that before installing Windows 98. I'll talk more about this later.

Upgrade options

Basically, you've got several options when it comes to installing the Windows 98 Upgrade. You can upgrade from Windows 3.1x or from Windows 95, or you can perform a new installation.

In my case, I decided to completely trash my existing setup, reformat the drives and do a clean installation. This has several advantages. For starters, there are no redundant files left on your drives. Theoretically, what you wind up with is a fresh operating system without any of the unnecessary baggage left over from previous system installations and upgrades.

A clean installation also provides the opportunity to reformat the disc drives. This not only ensures a couple of healthy drives but also automatically gets rid of any applications that are no longer used. Basically, you can use the new operating system as an excuse to do a full system cleanup.

What about the cons? Well, you do have to reinstall all your applications and replace any data files from backups. And that can be a bit tedious if you have to also install patches or updates for your applications. In my case, I simply backed up the files I wanted to keep using a borrowed portable ZIP drive.

Boot floppy

Because the Windows 98 Upgrade comes on a CD-ROM (you can order floppies if you wish), you must have your CD-ROM drive working in order to install it. And here's the catch – if you reformat your hard drives, the CD-ROM drive will no longer work because there are no longer any driver files and no operating system to load them.

The way around this problem is to make a boot floppy and copy real-mode (16-bit) driver files for your CD-ROM to it. You then create suitable autoexec.bat and config.sys files on this boot floppy, to load these drivers.

For those that don't know how to go about this, here's the procedure.

If you are running Windows 3.11, it's dead easy. First, create a boot floppy (format a: /s/u) and copy your existing autoexec.bat and config.sys files to it. Now edit these two files on the floppy disc to remove any unnecessary device driver commands, while leaving the lines for the CD-ROM drive intact. You need to keep mscdex.exe (the CD extension file) in autoexec.bat, plus the relevant CD-ROM driver file in config.sys.

Don't forget to change the paths in the command lines so that they now point to the root directory of the A: drive, since this is where the drivers will be copied.

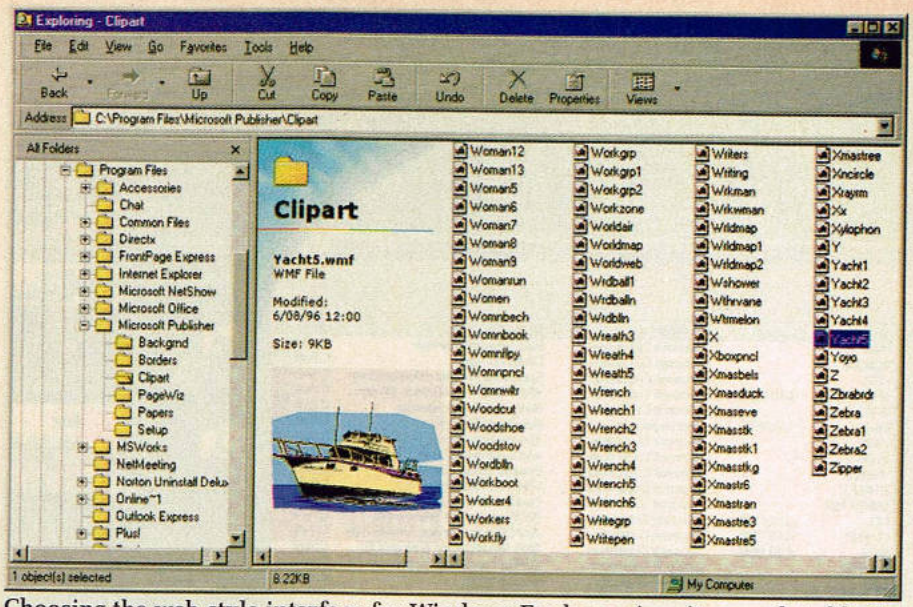
Next, copy mscdex.exe plus the relevant CD-ROM driver file to the boot floppy. A few other useful utilities can also be copied across at this time; eg, format.com, chkdsk.exe, scandisk.exe, attrib.exe and fdisk.exe. It's also not a bad idea to add himem.sys, emm386.exe and smartdrv.exe for memory management and to edit config.sys and autoexec.bat to load these (smartdrv.exe will provide caching for the CD-ROM drive and speed up the installation).

If you're currently running Windows 95 the procedure is somewhat different because real-mode drivers for the CD-ROM are not normally part of the installation. Instead, you have to get them from the installation disc that came with the CD-ROM drive.

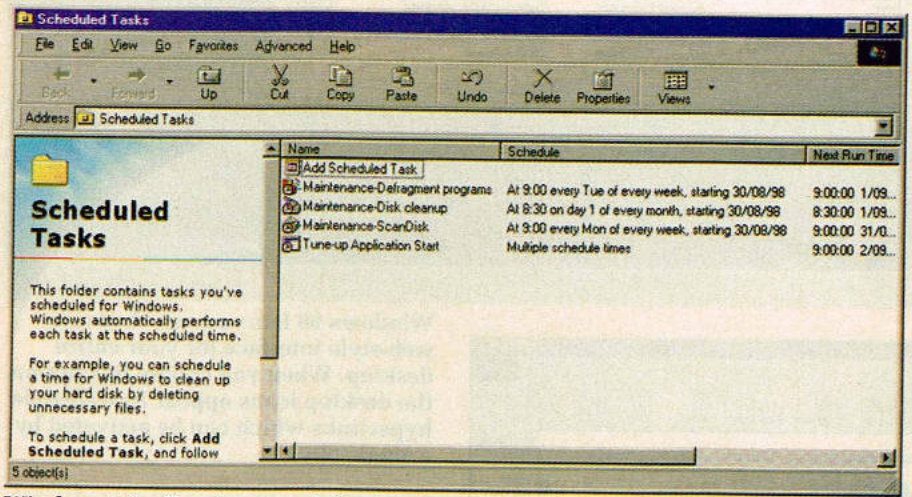
The first step is to make a Windows 95 startup disc and you do this by double-clicking the Add/Remove Programs icon in Control Panel, then clicking the Startup Disk tab and clicking the Create Disk button. When this has been done, make backup copies of your existing autoexec.bat and config.sys files, then restart the computer in DOS mode (click Start, Shut Down and choose "Restart the computer in MS-DOS mode?").

Once you're at the DOS prompt, go to the root directory of the C: drive and install the DOS-mode CD drivers from the floppy disc supplied with the CD-ROM drive. This will copy all the necessary driver files to a directory on your hard disc and add the necessary command lines to autoexec.bat and config.sys.

You now copy the modified autoexec.bat and config.sys to your startup disc, along with the newly installed driver files. As before, you need



Choosing the web-style interface for Windows Explorer gives it an updated look that's more consistent with Internet Explorer's interface. The Back, Forward and Up buttons make it easy to navigate between folders and you get a thumbnail preview of selected graphics and html files.


Scheduled Tasks
File Edit View Go Favorites Advanced Help
Back Forward Up Cut Copy Paste Undo Delete Properties Views
Address Scheduled Tasks
Scheduled Tasks
This folder contains tasks you've scheduled for Windows. Windows automatically performs each task at the scheduled time.
For example, you can schedule a time for Windows to clean up your hard disk by deleting unnecessary files.
To schedule a task, click Add Scheduled Task, and follow
Name
Schedule
Next Run Time
Add Scheduled Task
Maintenance-Defragment programs
At 9:00 every Tue of every week, starting 30/08/98
9:00:00 1/09...
Maintenance-Disk cleanup
At 8:30 on day 1 of every month, starting 30/08/98
8:30:00 1/09...
Maintenance-ScanDisk
At 9:00 every Mon of every week, starting 30/08/98
9:00:00 31/0...
Tune-up Application Start
Multiple schedule times
9:00:00 2/09...
5 object(s)

Windows 98 offers improved disc maintenance utilities, including a Maintenance Wizard that lets you automatically schedule certain tasks.

mscdex.exe plus the CD-ROM driver file. You can tell where these files are on the hard drive by looking at the paths in the command lines in autoexec.bat and config.sys. Don't forget to edit these two files as before, to get rid of unnecessary device drivers and to point the CD-ROM command lines to the drivers on the floppy disc.

Finally, reinstate your original config.sys and autoexec.bat files on the C: drive, then restart the machine using the boot floppy. Check that the CD-ROM drive works by inserting a CD-ROM, then typing Dir D: at the DOS prompt, where D: is the drive letter of your CD-ROM. If it works, you're in business.

Fig.1 shows the autoexec.bat and config.sys files used for my machine. Note that the switch /L:R in the mscdex.exe command line means that the CD-ROM drive will be drive R:. If you don't have this switch, the CD-ROM will assume the next drive letter after the hard disc drive(s). Note that the driver file required for your particular CD-ROM drive will probably differ from that shown in Fig.1.

Updating the BIOS

OK, so what about that BIOS update, to improve support for the AMD K6 processor? This would have to be done next, before I reformatted the drives.

The motherboard is an ASUS brand (model P/I-P55T2P4, to be exact) and their web site URL (www.asus.com) was easy to guess. In fact, this web site is excellent and I soon found the required BIOS update for my particular motherboard. Among the "fixes" listed for the update was support for the AMD K6 processor, so that was encouraging.

As well as the BIOS update, I also downloaded a small utility (called pflash.exe) to flash the BIOS, plus a text file with the instructions.

Now a BIOS update is quite easy to do but it's not recommended for novices. If you make a mess of things, you can end up with a corrupted BIOS and a computer that won't boot. The only way out of this sort of mess is to obtain a new BIOS chip from your supplier (or get them to re-flash the old chip if they have that capability). If you can't get a new BIOS, you're really left stranded right up that proverbial creek, without a paddle.

The best advice here is "if it ain't broke, don't fix it".

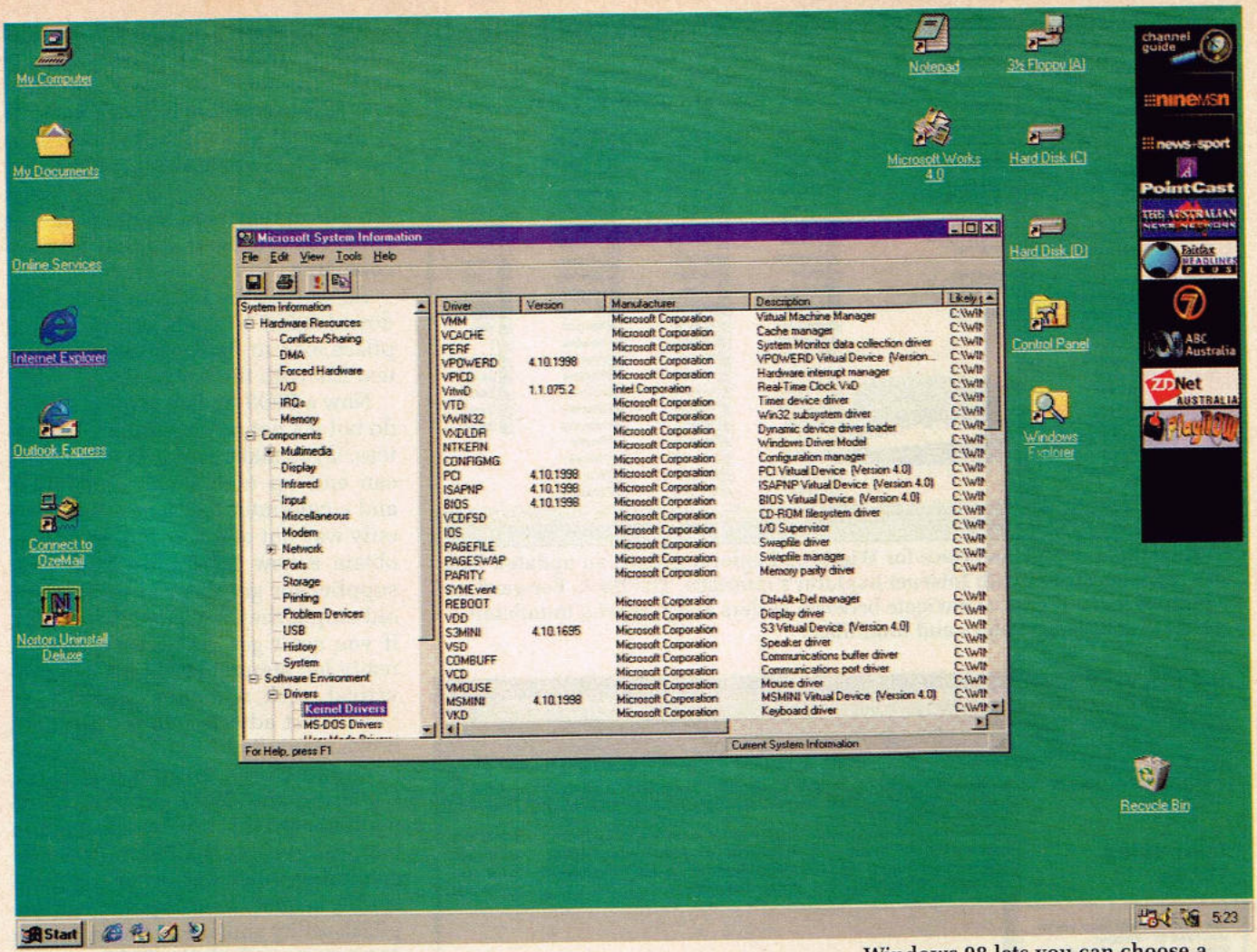
Anyway, back to the job at hand. Updating the BIOS on the ASUS motherboard first involves changing a jumper to enable the Flash BIOS programming capability. After that, you simply reboot the computer, run the pflash utility and follow the on-screen prompts to re-flash the BIOS.

And that solved the problem. When I rebooted the machine, the BIOS now informed me that I had an AMD K6 running at 200MHz. Strangely enough, Windows 95 didn't take to the BIOS upgrade and refused to load – this despite the fact that a previous BIOS update hadn't fazed it.

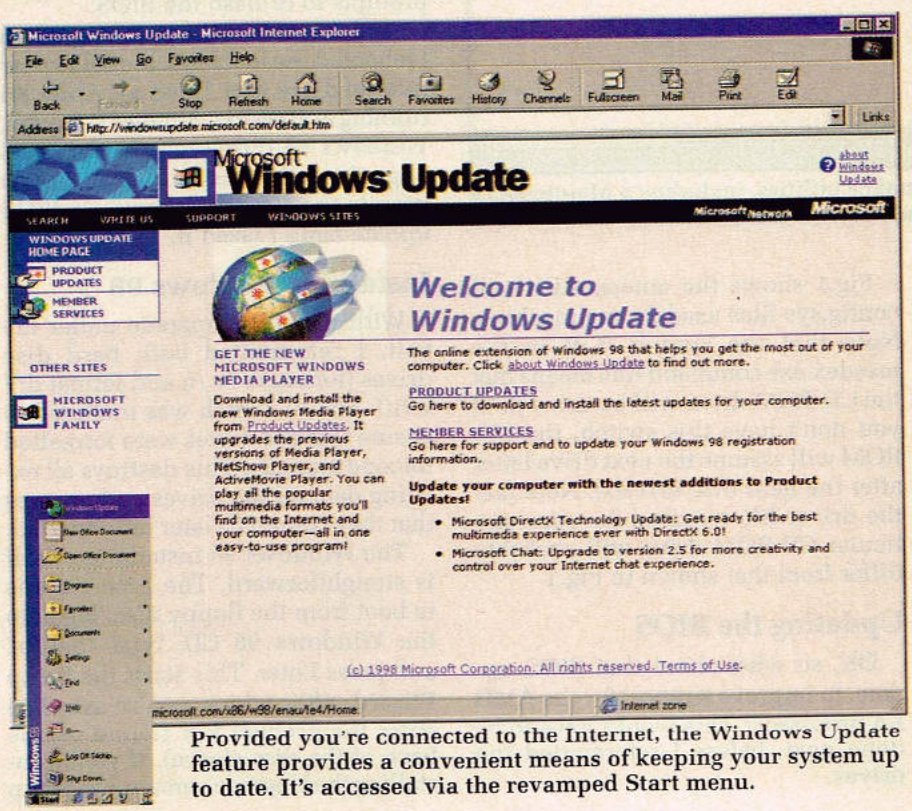
Installing Windows 98

With the BIOS upgrade under my belt, I reformatted both hard disc drives (format c: /v /u and format d: / v /u). The /u switch was included to ensure that the drives were formatted unconditionally. This destroys all existing data on the drives and ensures that they cannot be later unformatted.

The Windows 98 installation itself is straightforward. The procedure is to boot from the floppy disc, logon to the Windows 98 CD, type "Setup" and press Enter. This starts the Setup Wizard, after which you're asked to enter the product key (found on the back of the disc sleeve). If you're installing the Upgrade version, the Setup



Windows 98 lets you can choose a web-style interface for your entire desktop. When you choose this option, the desktop icons appear as web-style hyperlinks which can be activated by a single click.


Microsoft Windows Update - Microsoft Internet Explorer
File Edit View Go Favorites Help
Address http://windowsupdate.microsoft.com/default.htm
Microsoft Windows Update
Welcome to Windows Update
GET THE NEW MICROSOFT WINDOWS MEDIA PLAYER
PRODUCT UPDATES
MEMBER SERVICES
OTHER SITES
MICROSOFT WINDOWS FAMILY
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Internet zone

Provided you're connected to the Internet, the Windows Update feature provides a convenient means of keeping your system up to date. It's accessed via the revamped Start menu.

Wizard also does an upgrade compliance check, which means that you must have a full version of either Windows 95 or Windows 3.1 on hand.

During the compliance check, you'll be asked to insert either your Windows 95 CD or Windows 3.1 discs. This can be a trifle annoying because, in the latter case, it wants to "see" no less than six floppy discs. Once the wizard is satisfied that you have a "full" version, it proceeds with the installation.

I strongly recommend that you select the Custom option when the Setup options dialog box appears. This not only lets you add features that are not installed by default but also lets you delete space-consuming features that you don't need. At some stage, you'll

also be directed to create a Startup disc so be sure to set aside a clean floppy disc before starting the installation.

Don't imagine for a minute that the whole process will be finished while you have a cup of coffee – you'll need several cups, in fact. Depending on the speed of your CD-ROM drive, the whole process can take the best part of an hour. During the installation, the Setup Wizard automatically restarts the computer several times and there's a great deal of hard disc activity as the system identifies you hardware configuration and copies the driver files and other system files across.

In my case, it all worked perfectly. Windows 98 correctly identified my Diamond Stealth video card, a non-PnP SoundBlaster 16 soundcard and a non-PnP Adaptec SCSI controller and installed the correct drivers for them. It also correctly identified an external modem plugged into COM2 and installed the drivers.

By the way, if you are using non-PnP (legacy) expansion cards, be sure to reserve their IRQs in the system BIOS (if you have a PnP BIOS, that is) before installing Windows 98. This must be done for everything to work reliably. By reserving the legacy card IRQs in the BIOS, you let the operating system know which IRQs have already been assigned, thereby leaving it free to correctly assign the remaining IRQs to PnP cards. Further information on this subject can be found on page 8 of the June 1998 issue.

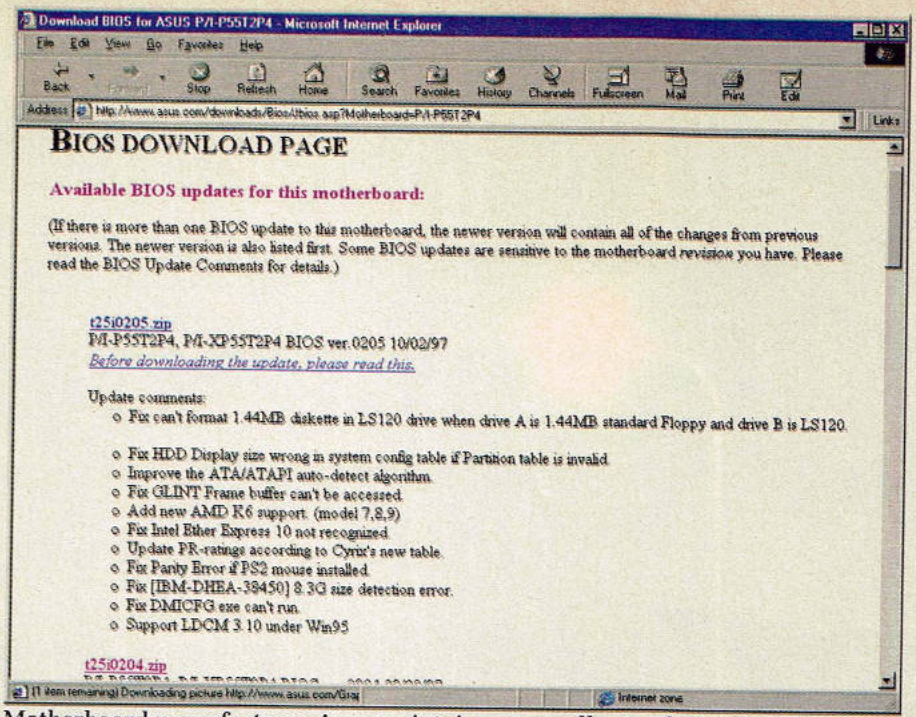
What's it like?

Is Windows 98 worthwhile? In my opinion, yes, particularly if you're currently running the "A" version of Windows 95 or if you have Windows 3.1x. Bear in mind, however, that you need plenty of disc space to install it (around 200Mb) and you should preferably have 32Mb of RAM or more, if your applications demand it. Yes, you can get away with 16Mb but 32Mb will noticeably improve the performance.

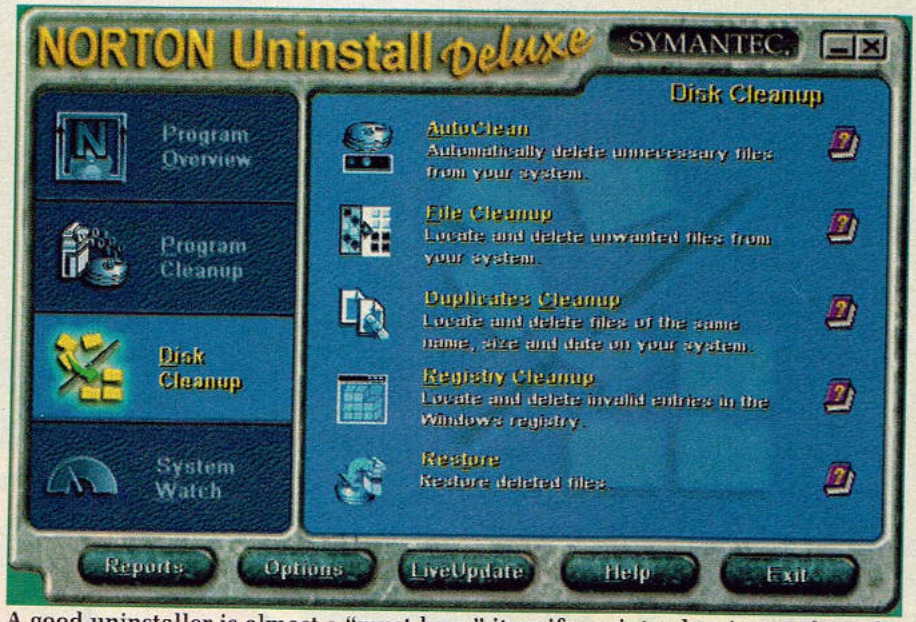
Based on my own observations, the installation is very stable. The FAT32 converter works like a charm too and I managed to recover some worthwhile space by running the conversion. I'm not too sure about the one-click active desktop option as yet but I'm prepared to give it a go. It's easy to switch back to the familiar double-click interface if you can't take to it.

Of course, not everyone will experience a hassle-free upgrade, especially if you elect to install over the top of an existing system. You might require an updated driver for your video card or sound card in order for them to work correctly with Windows 98, for example. Suitable updates can usually be downloaded from the manufacturer's web site.

If you have a brand name computer, check the manufacturer's web site for upgrade advice. For example, both Gateway and Dell offer Windows 98 upgrade advice on their web sites and even list drivers that you can download to correct any problems with specific hardware items (eg, soundcards and video cards). **SC**

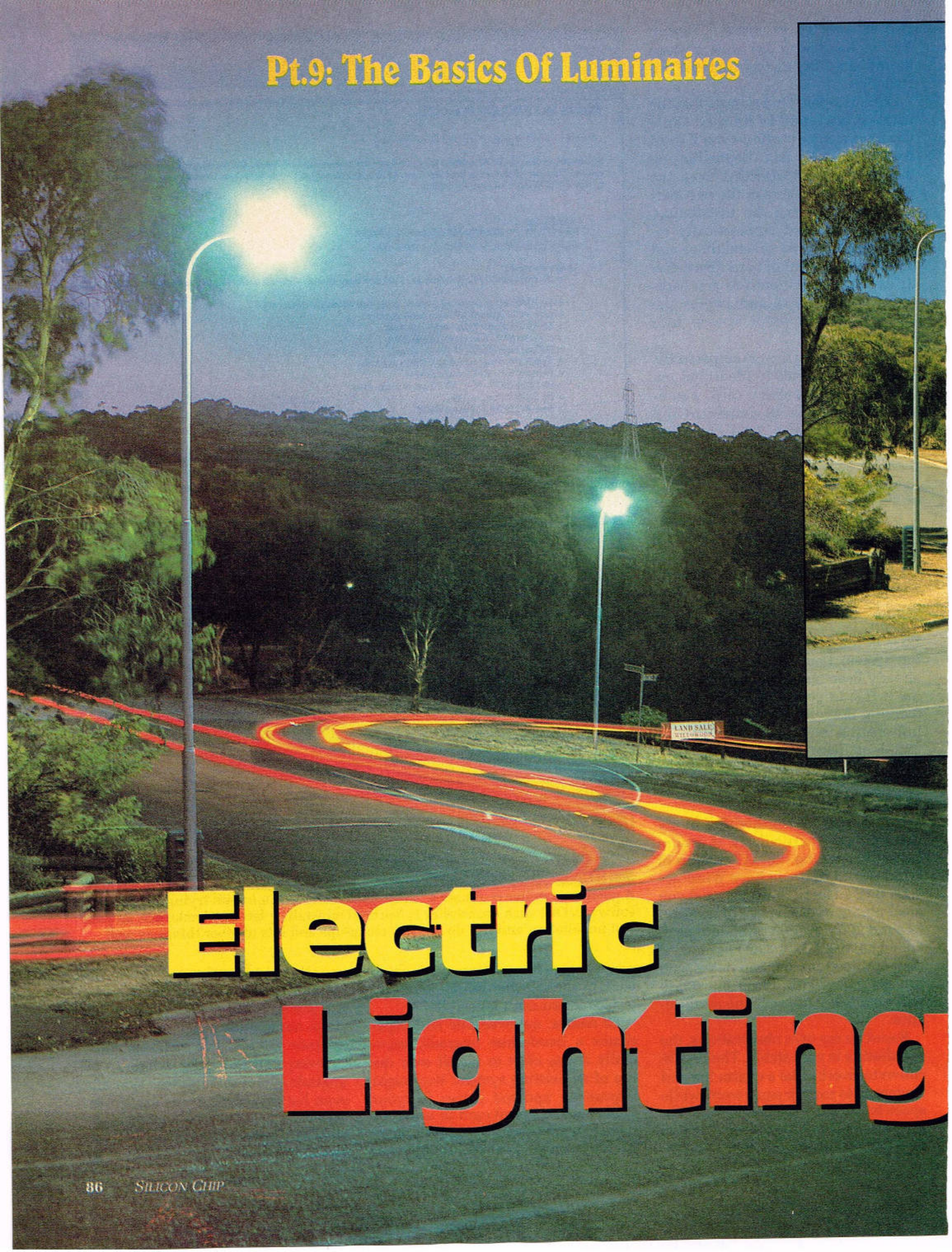

Download BIOS for ASUS P/I-P55T2P4 - Microsoft Internet Explorer
BIOS DOWNLOAD PAGE
Available BIOS updates for this motherboard:
(If there is more than one BIOS update to this motherboard, the newer version will contain all of the changes from previous versions. The newer version is also listed first. Some BIOS updates are sensitive to the motherboard revision you have. Please read the BIOS Update Comments for details.)
t25i0205.zip
P/I-P55T2P4, P/I-XP55T2P4 BIOS ver 0205 10/02/97
Before downloading the update, please read this.
Update comments:
Fix can't format 1.44MB diskette in LS120 drive when drive A is 1.44MB standard Floppy and drive B is LS120.
Fix HDD Display size wrong in system config table if Partition table is invalid.
Improve the ATA/ATAPI auto-detect algorithm.
Fix GLINT Frame buffer can't be accessed.
Add new AMD K6 support. (model 7,8,9)
Fix Intel Ether Express 10 not recognized.
Update PR-ratings according to Cyrix's new table.
Fix Parity Error if PS2 mouse installed.
Fix [IBM-DHEA-38450] 8.3G size detection error.
Fix DMICFG.exe can't run.
Support LDCM 3.10 under Win95
t25i0204.zip

Motherboard manufacturer Asus maintains an excellent web site that lets you easily find and download the latest BIOS updates for their products.

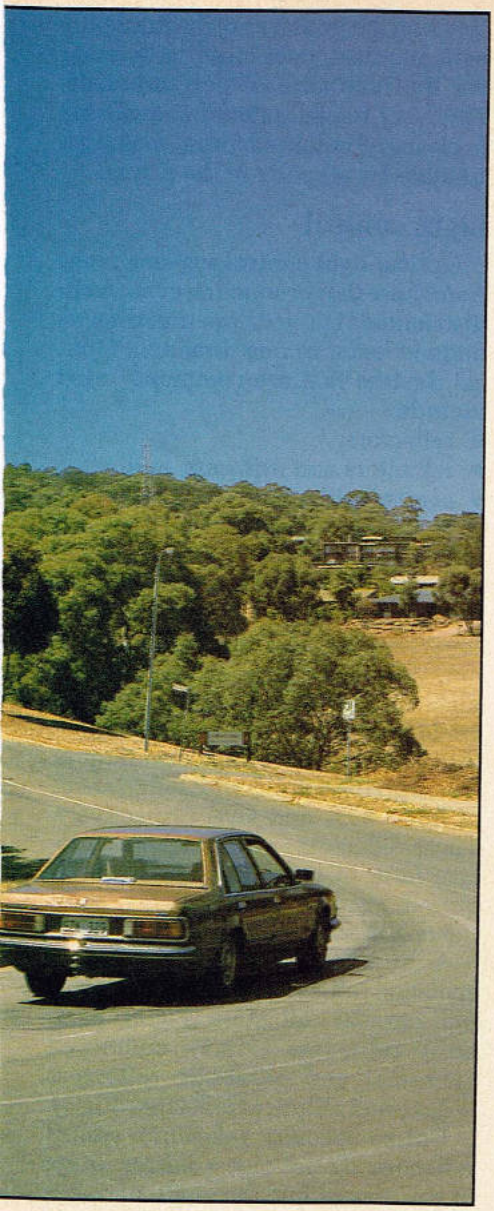


A good uninstaller is almost a "must-have" item if you intend trying out lots of software. One such uninstaller is Norton Uninstall. It lets you backtrack on your last installation and can do registry clean-ups and lots of other things as well.

Pt.9: The Basics Of Luminaires



Electric Lighting



ABOVE & FACING PAGE: **The same scene, by day and by night. The luminaires used to illuminate this road are the B2224 Series, manufactured by Sylvania. They use a diecast aluminium chassis, polyethylene injection moulded canopy and acrylic refractor. The refractor is secured with aluminium screws and the optics are silicone gasket sealed. During lamp changes, a wire lanyard holds the refractor in its open position. In this application the luminaires have been fitted with 80W mercury vapour lamps.**

Very few lamps are suspended naked in space. For aesthetic and functional reasons, the lamp is usually mounted within a fixture – a "luminaire" in lighting parlance. The design of the luminaire has a major bearing on its luminous intensity, durability and appearance.

By JULIAN EDGAR

In addition to having a pleasing appearance, a luminaire must:

- provide electrical connection to the lamp(s);
- physically protect the lamp(s);
- control and distribute the light from the lamp(s);
- be robust; and
- be efficient in use.

The wiring used inside a luminaire is normally of the solid core type. Because of its stiffness, fewer ties are needed to hold solid core wire in position and it is easily stripped of insulation. However, where the luminaire is subject to vibration or if the wire will be frequently bent (eg, in an adjustable spotlight), stranded wire is used.

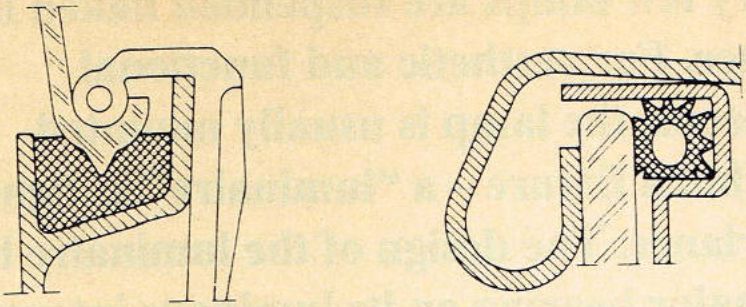
The ability of the wiring's insulation to withstand high temperatures is very important. Not only is the temperature of the air within the luminaire likely to be elevated above ambient but components such as ballasts and lamp holders can become very hot. Generally, PVC insulation with a heat rating of 90°C, 105°C or 115°C is used. In high-intensity discharge floodlights, even higher temperatures may be present. In these lights, silicone rubber (170-200°C) and PTFE (250°C) insulation is used, sometimes with glass-fibre sleeves.

Protection of the lamp is also important in many situations. If the lamp is to be used outdoors, for example, the luminaire must prevent the ingress of dust and moisture. As well, it may also be designed to protect the lamp against physical damage; eg, from children playing ball or from vandalism.

Dust and moisture protection requires that the lamp be fully enclosed, with a light-transmitting front panel fitted. So that the lamp can be changed when it fails, the cover needs to be detachable, necessitating the use of a seal around its aperture. Seals can be made of felt, silicone rubber, norprene, or neoprene. Fig.1 shows two different sealing methods.

Protection against accidental damage and vandalism can be obtained by

This indoors luminaire is designed to add to the appearance of the lamp and to provide a broad spread of light. The lamp should be cleaned at regular intervals, to maintain light output.



(a) (b)

Fig.1: luminaires located outdoors use sealing mechanisms that allow them to remain weatherproof while still allowing the lamps to be easily changed. Fig.1(a) shows the waterproof edge seal used in a fluorescent luminaire, while Fig.1(b) shows the notched rubber seal used in a floodlight. (Philips Lighting Manual).

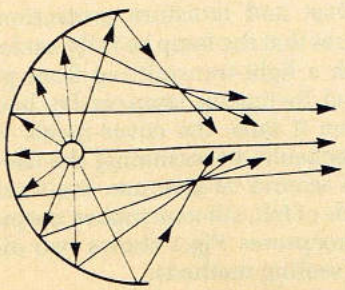


Fig.2: a circular reflector gives a broad spread of illuminance when the light source is at the focus, as depicted here. (Philips Lighting Manual).

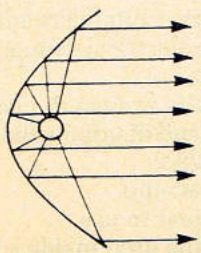
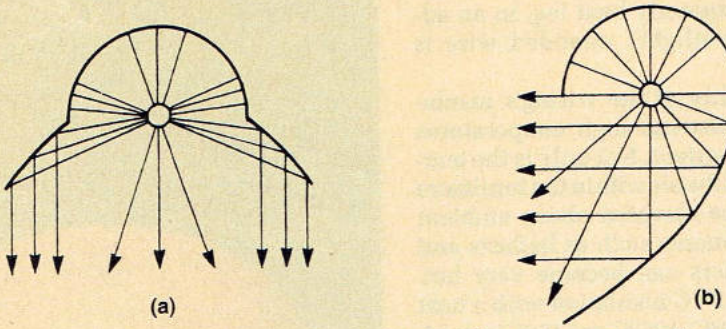


Fig.3: a parabolic reflector with the light source placed at the focus produces a parallel beam of reflected rays. (Philips Lighting Manual).



(a) (b)

Fig.4: combined spherical and parabolic reflectors are generally used in the two configurations shown here. In both cases, the spherical reflector diffuses the light from the source prior to reflection off the parabolic portion of the reflector. (Philips Lighting Manual).

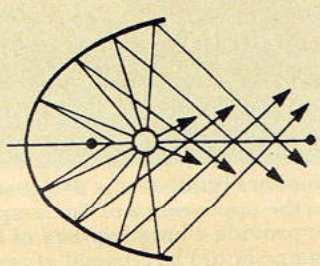


Fig.5: an elliptical reflector with the light source placed in front of the focus gives a "pinhole" effect and is commonly used in downlights. (Philips Lighting Manual).

covering the front face of the luminaire with stainless steel mesh or by making the luminaire of polycarbonate. This very tough material is available in clear and coloured forms, making it suitable for all parts of the fitting.

Light control

Optical light control systems range from those that produce an even, well-distributed light to those that direct a defined beam in one direction. Optical devices that are commonly used include:

- reflectors;
- refractors and diffusers; and
- screening devices.

There are three different types of reflectors: specular, spread and diffuse. Specular reflectors use a mirror-like surface. Materials used in such luminaires include anodised aluminium, aluminised glass and aluminised plastics. Alternatively, commercial grade aluminium can be clad with a thin layer of very pure aluminium or silver, giving a finish with reflectances of up to 80% and 90% respectively. These reflectors are used where a precise form of light distribution is required, such as in floodlights, spotlights and road lighting luminaires.

A number of different shaped specular reflectors are used, including: circular reflectors (Fig.2), parabolic reflectors (Fig.3), combined spherical and parabolic reflectors (Fig.4), and elliptical reflectors (Fig.5).

Unlike specular reflectors, spread reflectors do not give a mirror image of the source but the angle of maximum reflected intensity still equals the angle of incidence. A spread reflector gives a very even distribution of light, with the reflecting surface de-emphasising any hot spots caused by manufacturing inaccuracies in the shape of the reflector.

Spread reflectors are commonly made from polished aluminium, hammered or moulded into a pattern consisting of small bumps or dimples. Alternatively, the aluminium can be brushed. The spread reflector is used where an even light distribution is required.

Diffuse reflectors

Diffuse reflectors scatter the light widely. The shape of the reflector has only a general bearing on the resulting light distribution, so sharp beam control is not possible. Diffuse reflec-

tors are cheaply produced using glossy white-painted steel or white-coloured plastic. This type of reflector is commonly fitted to fluorescent luminaires.

Refractors are used to control the direction of the light emitted by the lamp(s), primarily to stop glare. Glare occurs in the viewing angle between 45° and 90° to the vertical axis beneath the luminaire – see Fig.6. Refractors reduce the illuminance in this glare zone, directing the light down rather than outwards.

Most fluorescent luminaires use a refractor consisting of an acrylic or polystyrene panel that is smooth on top and has many small conical prisms on the underside. The refractor fitted to a 2-lamp fluorescent luminaire can have as many as 5000 prisms moulded into it.

Screening devices

An alternative approach to controlling glare is to use screening devices such as louvres or baffles. These are often used in fluorescent luminaires and Fig.7 shows the screening effect of the reflector used in such a luminaire. Another approach is to recess the luminaire into the ceiling so that the lamp(s) cannot be seen from directions where glare could be a problem. In floodlights, spill light to one side of the beam is sometimes blocked by a baffle.

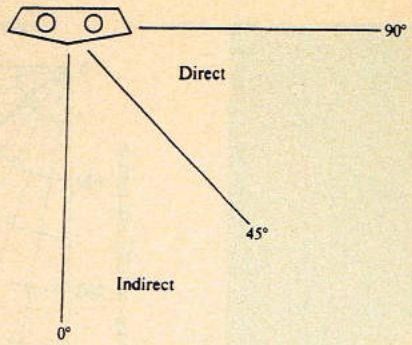


Fig.6: direct glare from a luminaire is most likely to be a problem at an angle of 45-90° from the vert-ical. (Murdoch, J., Illumination Engineering).

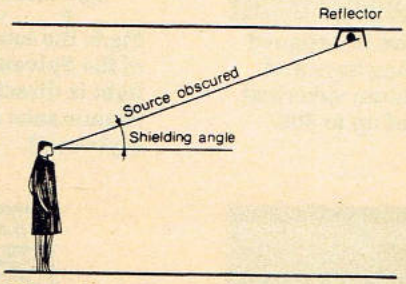


Fig.7: the amount of glare can be considerably reduced by using a screen to obscure the light source. (de Boer, J & Fischer, D., Interior Lighting).

If uncleaned for three years, an indirect up-light in a dirty environment will typically have its light output reduced by 55%!

Luminous intensity distribution

Manufacturers generally produce a great deal of photometric data for their luminaires, with luminous intensity distribution being one of the most important. The luminous intensity distribution curve reflects (pun intended!) the design of the luminaire, being affected by the combination of direct, reflected and diffused light emanating from the luminaire.

Fig.8 shows a Sylvania Indy Series luminaire. This large luminaire is designed for high mounting in warehouses, loading bays and industrial plants. It is 545mm high and its spun aluminium elliptical reflector has an external diameter of 420mm. The luminaire can be fitted with lamps of up to 400 watts.

The luminous intensity distribution curve is shown in Fig.9 and this shows that most of the light is directed downwards, with very little illuminance at more than 40° from the vertical. As you would expect with a round reflector, the luminous intensity distribution of this luminaire is symmetrical around its vertical axis.

A luminaire which is superficially similar in appearance is shown in Fig.10. This is a Sylvania Sylvaglow, designed for mounting at relatively low heights, again in warehouses, factories and so on. Unlike the previous unit however, it uses a combination of spherical and parabolic specular reflectors and is fitted with a diffuser.

The luminous intensity distribution curve (Fig.11) shows that the illuminance spread from this luminaire is wider than for the previous case, with effective illumination at up to 50° from the vertical axis. However, the values of luminous intensity are well down over the other Sylvania luminaire, with luminous intensity being traded off against the luminaire's spread.

Light loss

It is the average maintained luminance that is the critical factor in assessing the effectiveness of a lighting installation. Light loss occurs through four different factors:

- lamp burn-outs;
- lamp lumen depreciation;
- luminaire dirt depreciation; and
- room surface dirt depreciation.

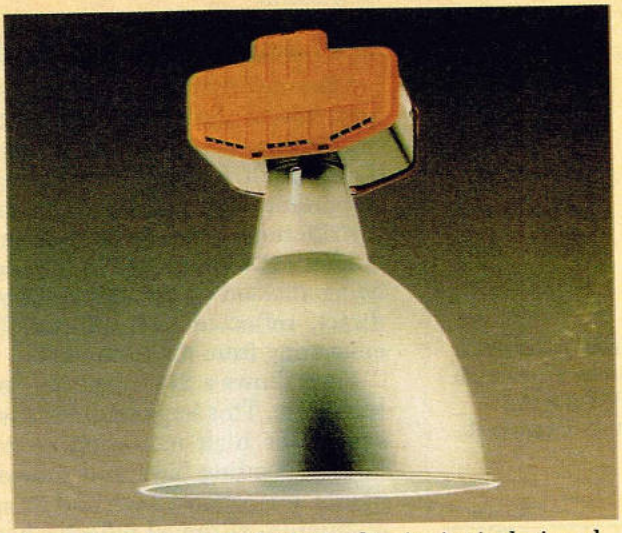


Fig.8: the Sylvania Indy Series luminaire is designed for high mounting in warehouses, loading bays and industrial plants. It uses a spun aluminium spherical reflector and can be fitted with lamps of up to 400 watts. (Sylvania).

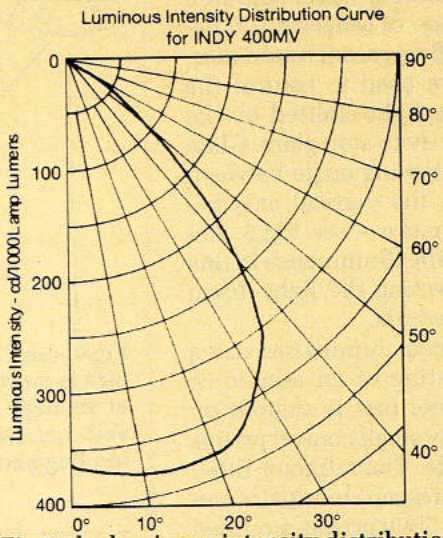


Fig.9: the luminous intensity distribution curve of the Sylvania Indy shows that most of the light is directed downwards, with very little illuminance at more than 40 from the vertical. (Sylvania).

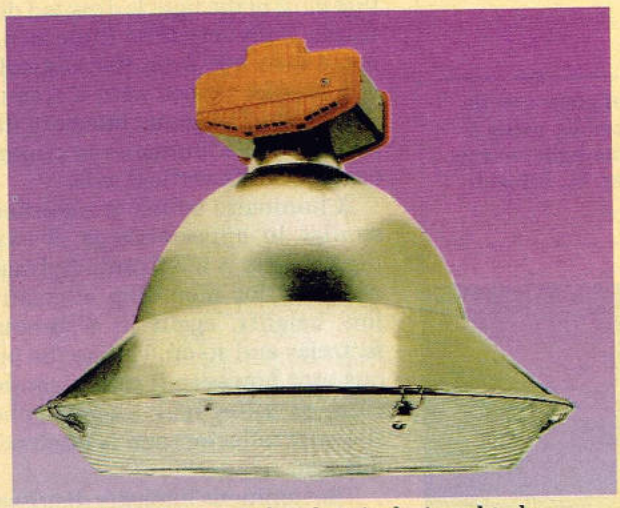


Fig.10: the Sylvania Sylvaglow is designed to be mounted at relatively low heights. It uses a combination of spherical and parabolic specular reflectors and is fitted with a diffuser. (Sylvania).

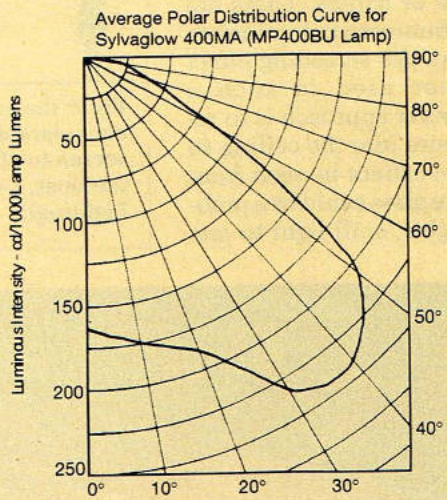


Fig.11: the luminous intensity distribution curve of the Sylvaglow shows that the spread of illuminance is wider than for the Indy. However, the luminous intensity values are much less. (Sylvania).

If a burnt-out lamp isn't immediately replaced, there will obviously be a noticeable decrease in luminance. In some situations, where replacement may not be immediate, the lighting design needs to take this into account.

Even prior to failure, the luminous flux of the lamps will have decreased compared to their new output. As it approaches the end of its life, an incandescent lamp will typically have a luminous flux of only 78-90% of its "new" figure, while a fluorescent lamp may be down to 72%. From this, it follows that if the illuminance is only just acceptable when the lamps are new, it will be quite unacceptable after a few thousand hours of operation.

Dirt build-up

However, it is dirt build-up on the luminaire that is the single greatest cause of light loss. The rate at which the light output decreases is dependent on the room cleanliness, luminaire design and, of course, on the frequency and thoroughness of luminaire cleaning.

As an indication, a bare lamp batten in a dirty environment will typically show a decease in light output of 17% after a year without cleaning! An even worse-case scenario is an indirect up-light in a dirty environment. If it's uncleaned for three years; its light output will typically decrease by about 55%.

Make sure that you regularly clean your luminaires! SC

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Splitting the distribution amplifier

I am currently installing a TV network including the distribution amplifier as described in the August 1996 issue of SILICON CHIP. It appears to be working however after requests by a number of mates for a similar network, a number of questions have arisen.

Can the two boards be connected by multi-strand wire rather than coax? Could the masthead board be placed up the mast and the power board be located inside? Would it be better to have two antennas and if so, could they be placed on the same mast? Is there a way to measure the signal loss/gain? (perhaps using an old VCR tuning section as hiring the equipment appears relatively expensive). (A. W., No address).

● You must use coax cable to connect the two PC boards but they can be separated, with the masthead board near the antenna. If you have two identical antennas, they need to be vertically spaced by at least half a wavelength at a midband frequency, for best results. We would try the system with one antenna first.

There is no easy way to measure signal loss or gain although if you have a wideband oscilloscope and a buffer preamp you can make usable measurements in the VHF band.

How to cripple Clifford the cricket

I have assembled the "Clifford the Cricket" kit as described in the December 1994 issue and it is operating but I find no delay time when the light is switched off. The cricket comes on almost instantly. Could this be remedied by altering the value of the 100µF capacitor at the input of IC1a? If so, what new value capacitor would be required? (E. R., Melbourne, Vic).

● If there is no switch-off delay then it is almost certain that the 100µF is effectively not in circuit. This could be because the capacitor itself is open-circuit or there is a cold solder joint or broken copper track. Try substituting another 100µF capacitor to see if that fixes the problem.

The dangers of over-voltage

I work from home repairing electronic items such as VCRs, car stereos and computers, etc. My computer is in our guest room and my guests have complained that the UPS alarm goes off most mornings about 5am or 6am. I thought it was possible that when everybody got up to go to work and put on their electric kettles that the mains voltage was dropping – hence the UPS alarm.

I connected my Metex M-3850D multimeter (with RS232 output) up to my old 286 and monitored the voltage early one morning and I found that the voltage is way too high at 260VAC. My Metex meter has been cross referenced with a Fluke 75 (recently calibrated by HP).

My questions are these:
(1). What damage can the over-voltage do to household appliances and computers? Most computers have 220VAC or 230VAC labels on the rear of them.
(2). Are we being overcharged for our electricity as we pay for the kWh used? I have calculated (roughly) that each appliance is using about 18% more power at the higher voltage.
(3). Do you have any suggestions as to how to handle my complaint with United Energy here in Melbourne? (C. H., Patterson Lakes, Vic).

● Your complaint about high mains voltage is all too common in rural and semi-rural areas. You will probably

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find that your local electricity distributor has very long lines and so they keep the voltage high to make sure that the supply at the end of the line is still adequate.

It is probable that a higher than nominal voltage does cause more appliance failures but whether it is appreciably higher is anybody's guess. Certainly, your incandescent lamps will not last long with a mains voltage which is typically 8% high and that may be the biggest cost. Other appliances with filaments, such as picture tubes in TV sets and computer monitors and heaters with spiral wound elements in fused silica tubes won't last as they should either.

You will also be paying more when running heating and lighting appliances since you have no control over this factor. Appliances with thermostats or switchmode power supplies will not use significantly more energy due to the fact that they maintain a specified internal voltage, temperature or whatever.

If you are concerned, you have two possible approaches. First, you can write to your local distributor (write a letter, don't phone – they are more likely to respond to a letter) outlining the problem and complain to them about reduced incandescent lamp life, having to pay for more power than you want and possible increased appliance failure rates.

Second, if you are concerned about a particular appliance, you may consider running it from an auto-transformer to reduce the supply voltage. We featured an article on this subject, entitled "Stop Blowing Incandescent Lights" in the January 1997 issue.

Problem with 10A speed controller

I am writing about the 10A speed controller described in the November 1997 issue of SILICON CHIP. A customer of ours has bought and assembled a kit based on your project. He has used the speed controller on a portable 700W Makita grinder. The BUP213 (IGBT) has failed after only a few hours use.

We have replaced the BUP213 for him and it has failed again after a short time. The BUP213 measures low resistance between any of the terminals. Can you advise any additional protection? (J. N., Seven Hills, NSW).

● We are concerned that the Makita grinder may be faulty in some way which causes it to draw very heavy currents. Perhaps it has shorted commutator segments or a shorted winding on the armature (rotor). This could be indicated if there is excessive sparking on the commutator when running directly from the mains.

We cannot suggest further protection measures for the BUP213 as it is already a very rugged device. We have not had any other complaints about failures of the BUP213. We are assuming, of course, that the existing protection components, ZD1, ZD2, D1 & MOV1, are all functioning correctly.

High energy ignition worthwhile on bikes

Regarding the use of the High Energy Ignition system with motorcycle engines (M. H., Wembley Downs, WA, "Ask Silicon Chip" September 1998), I agree with part of your reply – if the motorcycle already has a working breakerless electronic ignition then there's no point in replacing it with an HEI system. However, given the cost of factory replacements for Japanese bikes in particular, the HEI system could be an economical replacement for a faulty original unit.

But a word of caution before rushing in: many post-1975 Japanese single cylinder bikes use a purpose-built ignition control module, powered and triggered by coils wound into the alternator stator assembly and thus present no easy interface for the HEI. And many small capacity 2-stroke trail bikes have contact breaker points but their application is often more akin to a magneto than a conventional points-and-coil system.

The HEI can be readily applied to most 1960s to early 1970s 4-stroke single, 360° parallel twin and 4-cylinder-in-line motorcycle engines that still have points-and-coil ignition systems. The simple trick for a 360° parallel-twin engine is to use the one HEI unit, built to be triggered by both sets of points, to fire both coils together whenever either set of points opens. When either cylinder is at the end of its compression stroke, the other is at the end of its exhaust stroke, and the "spare" spark fires harmlessly into exhaust gas.

The two ignition coils can be connected in parallel – the current limiting of the HEI eases the load on the marginal Lucas electrical systems used on old British bikes in particular. This is not optimum but more reliable running and with indefinite points life is a big improvement on the original

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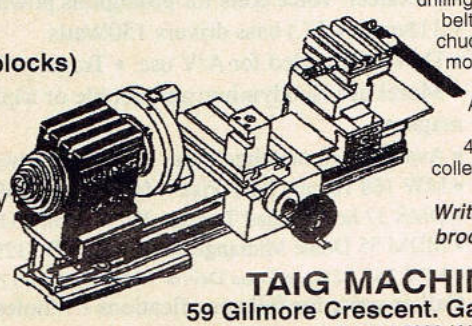

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Pointless approach to HEI

I have reviewed the design for the original ignition system and have concluded that points can still be used if the basics of the Kettering system are retained. The method is quite clear; instead of driving the electronics from the points directly, a suitable transformer is interposed between the point system and the electronics. This transformer must carry an unbalanced direct current of say 100mA and have a primary inductance of say 144mH and a DC resistance of 120Ω.

These values can be obtained with a single loop of 10/8/13 "C" core with say 500 turns spread over the two legs. The air gap is adjusted until the inductance is about right and the DC resistance can be padded out to 120Ω. The resulting output voltage is about 110V peak about 170µs after the points open. The secondary can be wound with say 25 turns to give about 5V which should be ample to drive the input of the electronic ignition unit.

With this current and voltage on the points, any semiconducting film should be broken down without seriously degrading the long point life occasioned by the low current. Whilst the pressure of my other projects does not permit me pursuing this idea for some time somebody may care to try it out and publish the results of a field trial.

I have now experienced two failures of the transistorised ignition system, both being caused by point fouling. Although I have used the power Mosfets, my front end is identical to that specified in your design. The R.A.C. serviceman who attended my breakdown commented that in his experience point fouling was a hallmark of retrofitted electronic ignition systems using points.

From my experiences I must therefore conclude that your paragraph on the wetting current in the points-controlled version referred to above does not lead to a reliable system and since the points are the weakest part of the Kettering system I would strongly recommend that if your readers elect to build an electronic ignition system then only the breakerless system should also be used. (R. B., Kalamunda, WA).

● The nominal wetting current in our original HEI design is around 250mA which should be sufficient to ensure reliable operation. Indeed, several of our own staff have run points/TAI systems in cars for many years without points fouling.

Even so, points do present problems with variable timing, bounce and in particular, rubbing block wear. If the points gap is not regularly adjusted to compensate for rubbing block wear, the system will eventually come to a complete halt.

By comparison, any breakerless system is a dream. It never needs adjustment, the engine runs more smoothly and dirt is never a problem. We can see no reason to persist with points.

system! For a much better result, the two 12V coils should be replaced by 6V coils and connected in series.

A 4-cylinder engine is just two 2-cylinder engines. Two HEI units can be used to trigger two pairs of coils. Most Japanese 4-cylinder bikes use this principle – they have two "double-ended" coils, each firing two plugs simultaneously, triggered by two sensors 180° apart on the camshaft. The "spare" sparks go harmlessly into those cylinders on their exhaust strokes.

One final caveat: before proceeding, make sure that you have a 2-stroke single or 4-stroke single, 360° parallel-twin, or in-line four. Don't try simultaneously firing the plugs on a 2-stroke twin! Also, some Japanese 4-stroke parallel-twins (especially the 250s) use a 180° crankshaft. When one piston is at the end of its compression stroke, the other piston is at the end of its inlet stroke. No prizes for guessing what happens when you fire a "spare" spark through that cylinder full of air/fuel mixture!

Similar problems may arise if you fire both plugs simultaneously on "V-twin" or horizontally-opposed engines. Do your homework and make sure you know what's going on in each cylinder before firing both plugs together. (D. J., Mulgrave, Vic).

Notes & Errata

12V Trickle Charger, October 1998: the circuit on page 75 shows the transformer with two 15V windings connected in parallel but there is only one winding connected to the bridge rectifier. The wiring diagram on page 77 is correct.

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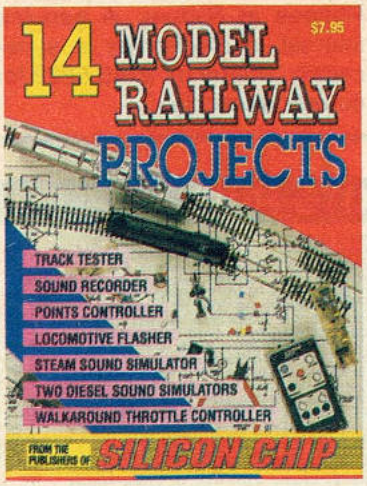

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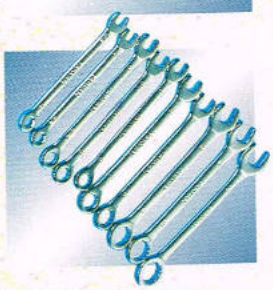

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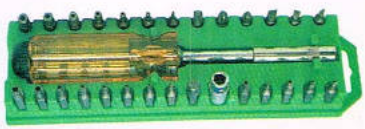

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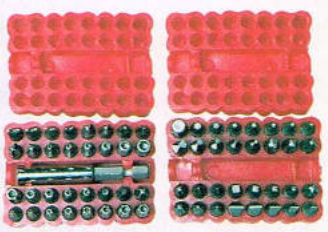
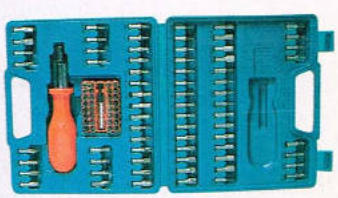


64pc security bit set

Packed into two soft plastic storage cases for easy carrying. With security Torx, Tri-wing, Hex, Phillips bits, magnetic bit holder and more.

T 4501

$26.95



101-piece bit set

Includes a hard plastic carry case, driver handle, and magnetised bit holder. With flat blade, Phillips, Square, Torx, Hex, Security Torx, Security Hex, Tri-wing, Spanner, Torque bits and more.

T 4513

$34.80

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